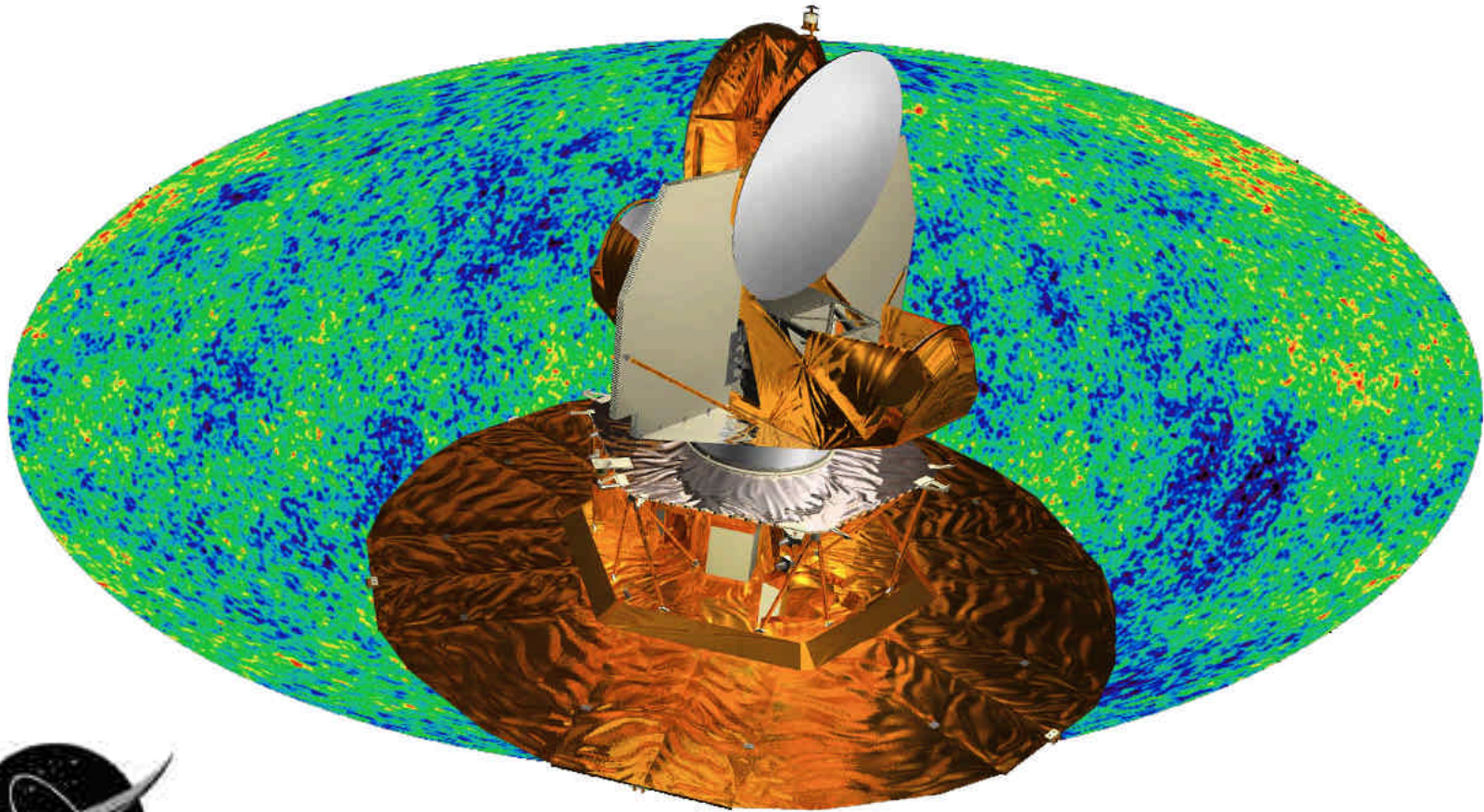


THE MAP MISSION

Unveiling the HISTORY, CONTENT, SHAPE, & DESTINY
of Our Universe



MAP Mission Readiness Briefing
Tuesday, June 5, 2001

Dr. Charles L. Bennett - 1

Science Team Members



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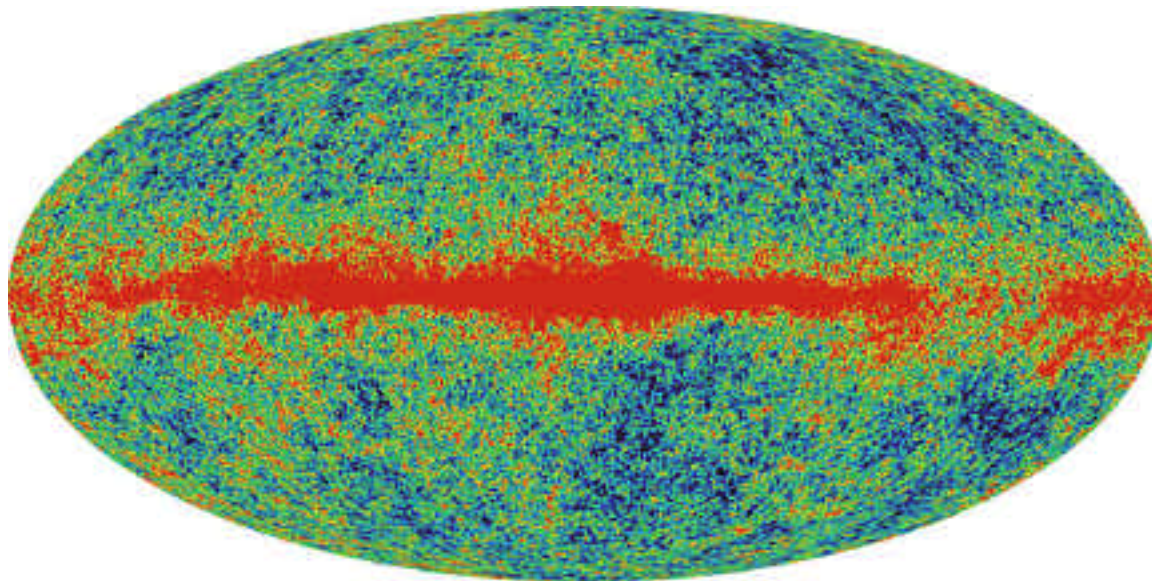
U. BRITISH COLUMBIA

M. Halpern

*COBE Veterans

MAP MISSION OBJECTIVE

*Make a sensitive, high resolution, full sky map
of the afterglow light from the Big Bang,
with unprecedented accuracy and precision,
to determine the cosmology of our universe*

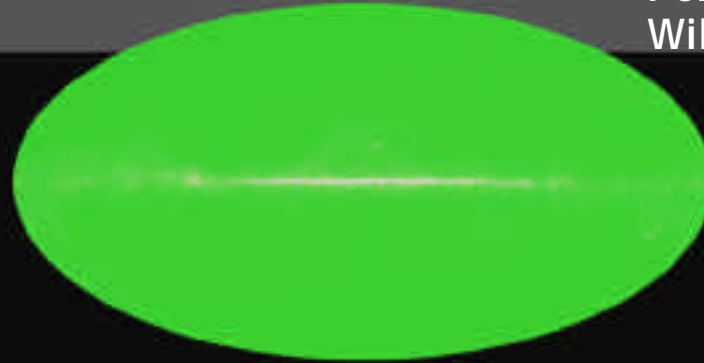


Simulated MAP Sky Image

1965



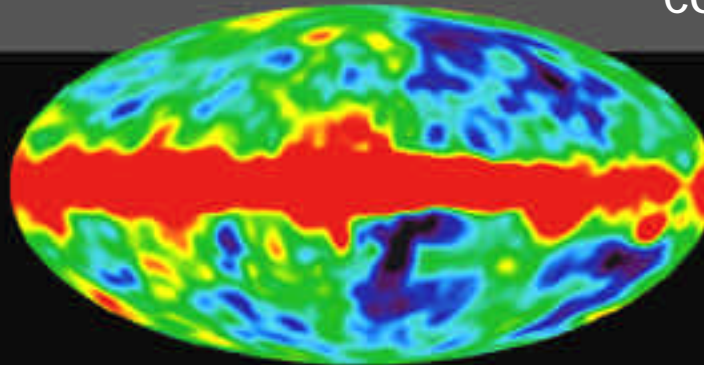
Penzias and
Wilson



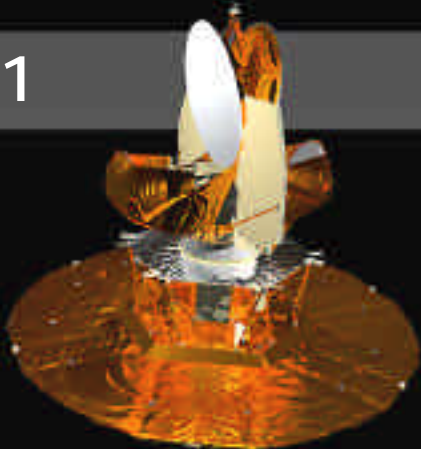
1992



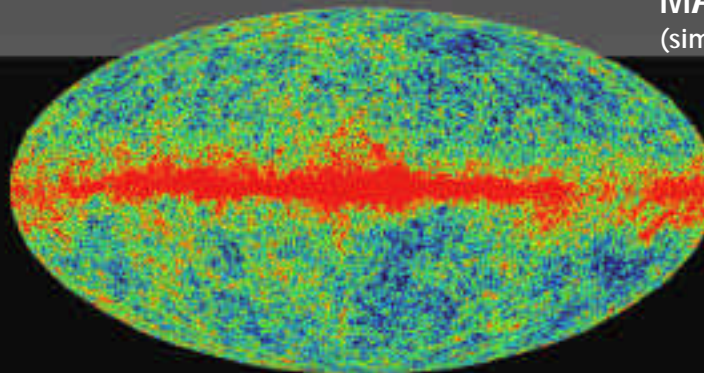
COBE

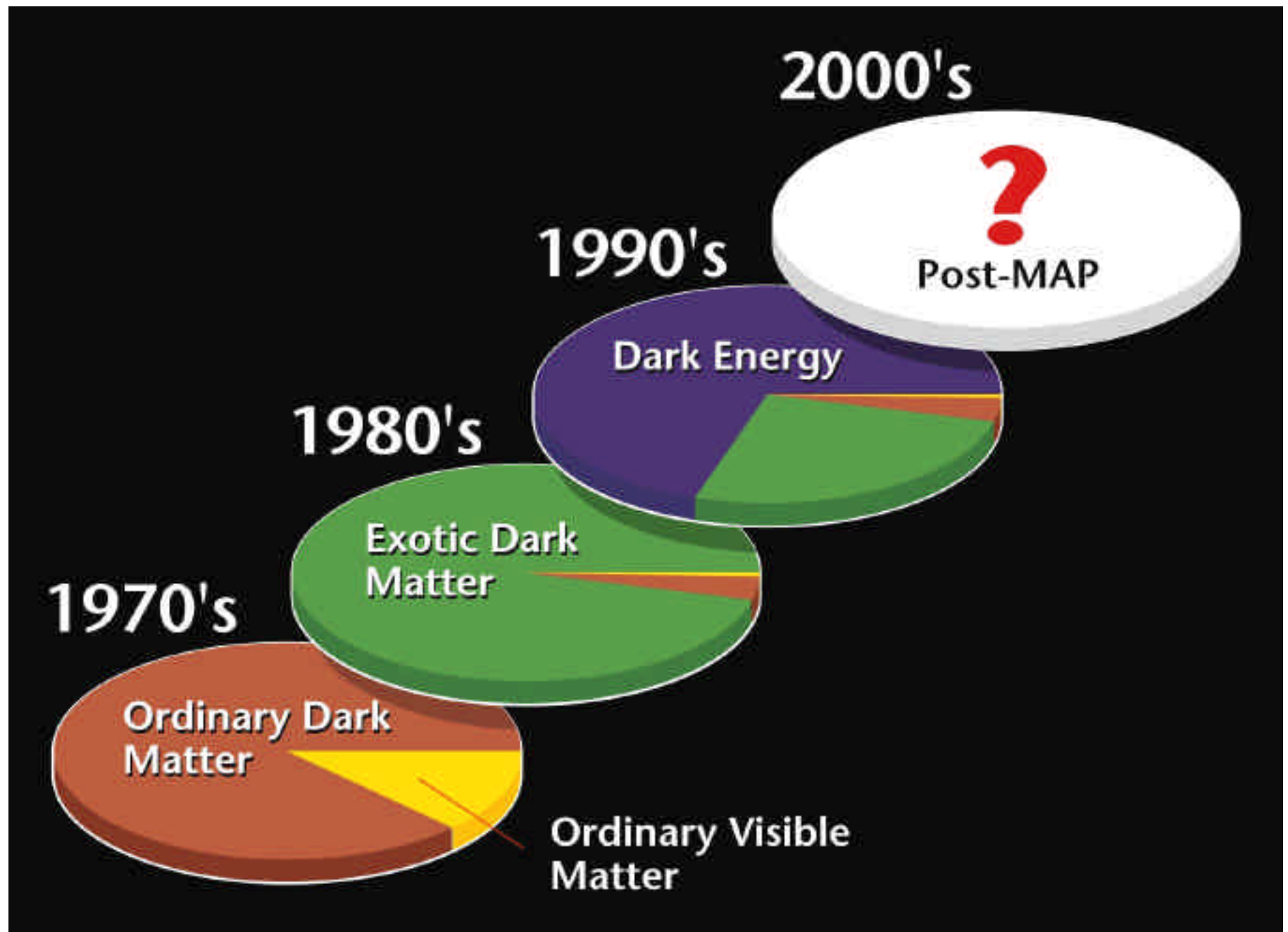


2001



MAP
(simulated)





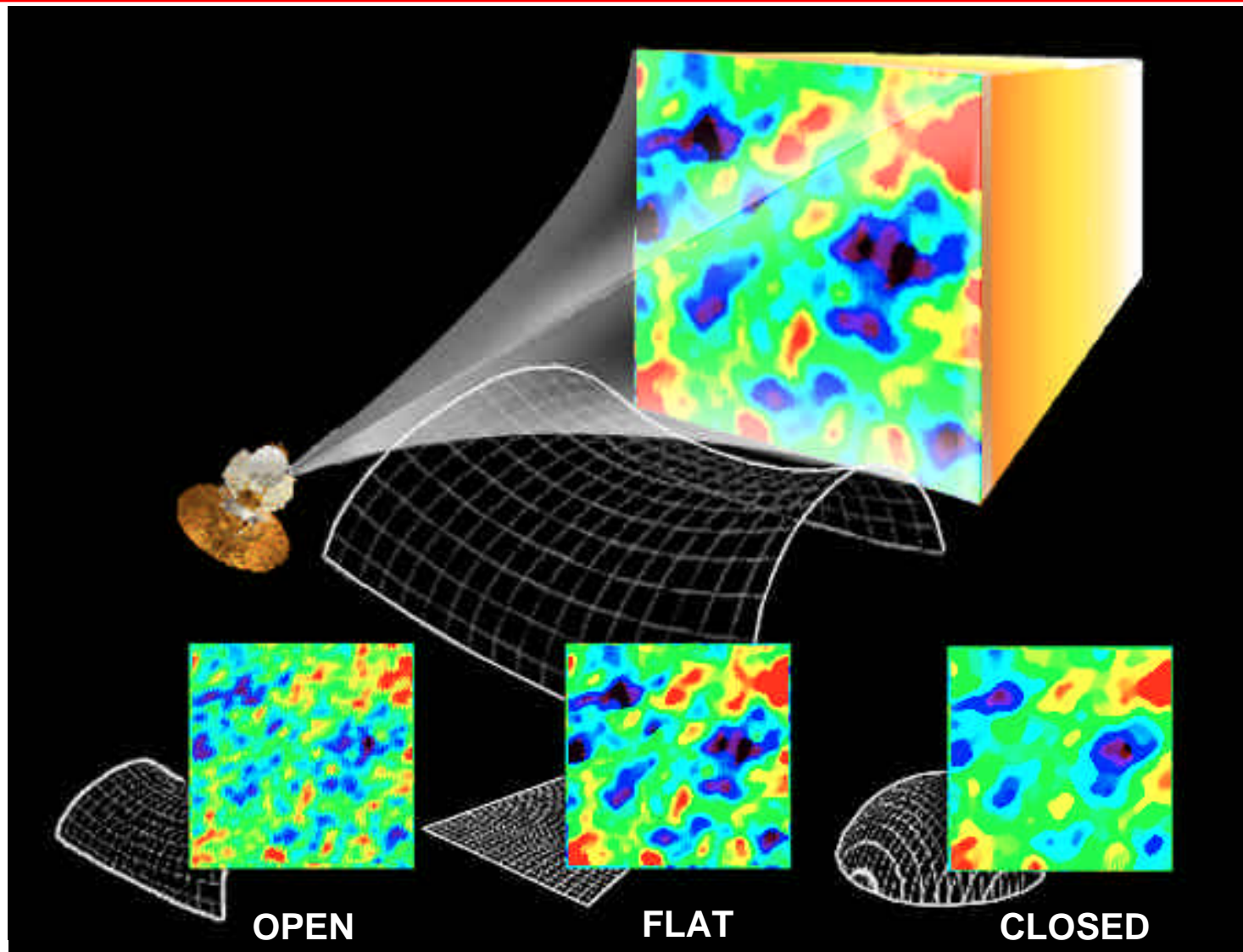
MAP: Testing Inflation

Inflation makes several specific predictions about the patterns of the afterglow light from the Big Bang

Acoustic peaks
Equal fluctuation power at all angles
Flat shape of Universe
Gaussian statistics
Polarization pattern

MAP will put Inflation Theory to a precise and accurate test

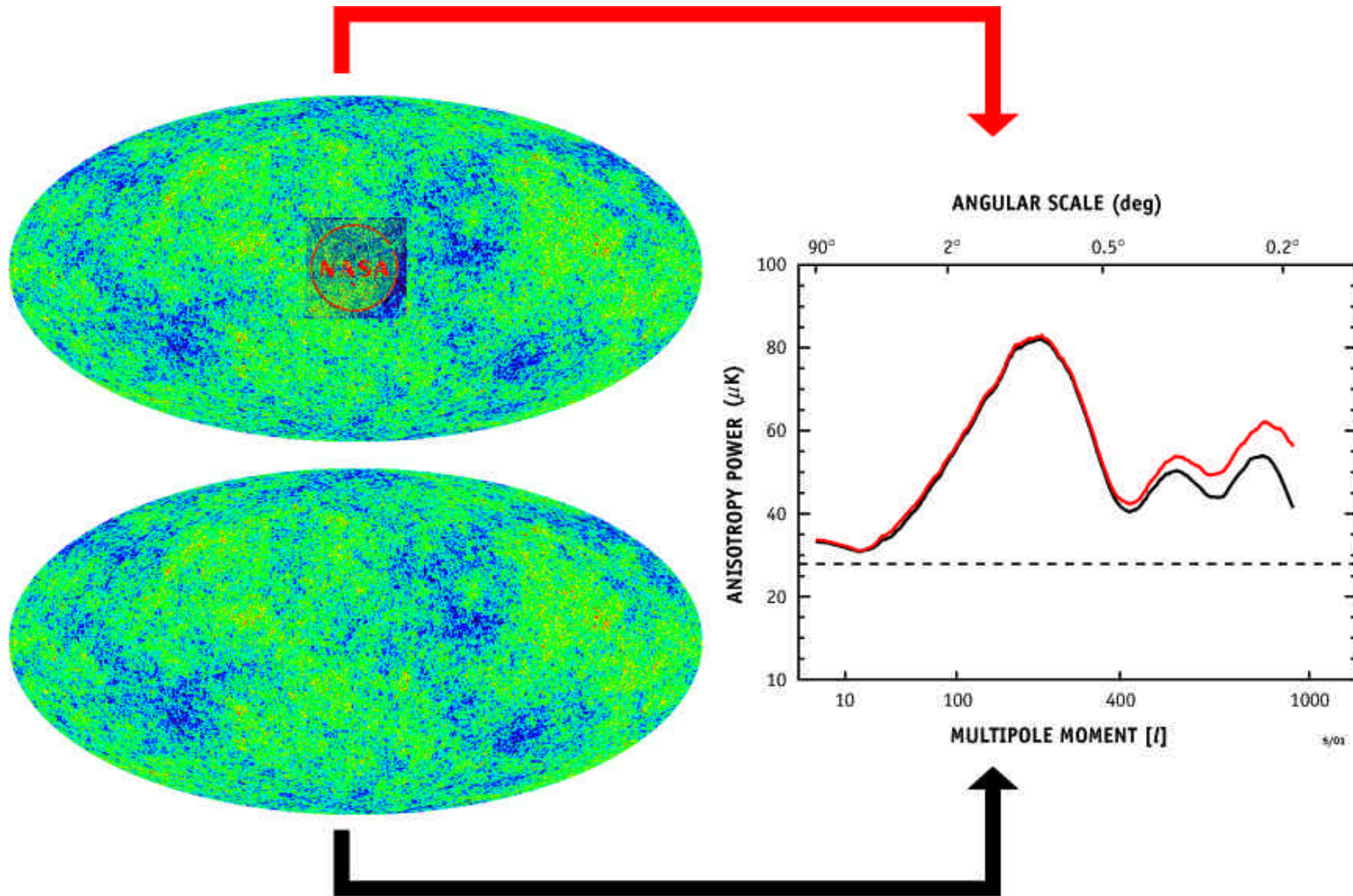
MAP Measures the Shape of the Universe



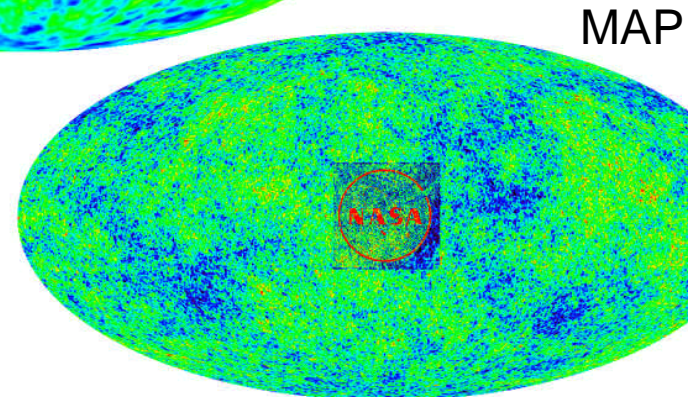
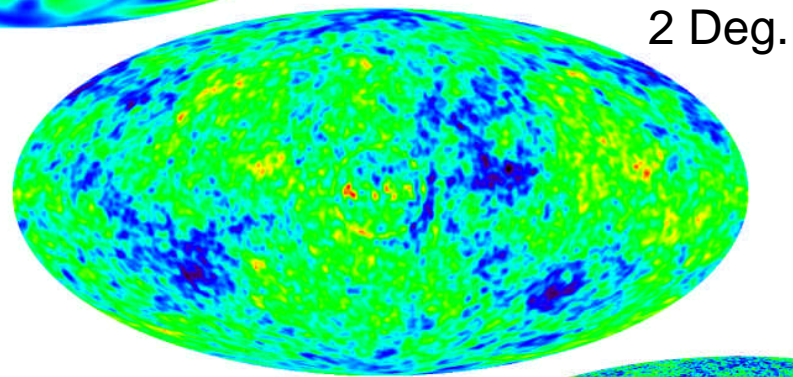
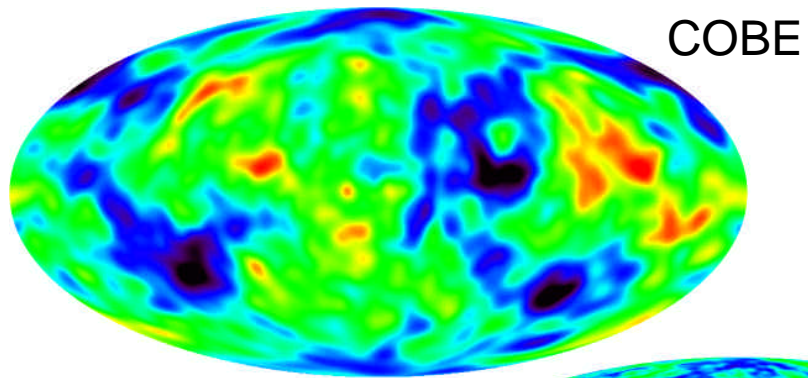
A True FULL-SKY Map

- CMB is precious -- Want most possible information
 - Intensity and polarization everywhere on sky
 - MAP measures full set of information
 - Accurate full sky map is best possible statistical sampling of the Universe
- Full sky map allows full range of statistical analyses
 - Power spectrum is only one statistic
 - Non-Gaussian patterns? (I.e. non-Inflationary)
- Best possible understanding of galactic contamination
- Cross-correlations with external data/observations
 - e.g. Sloan Survey, x-ray surveys, etc.
- Intangible benefit of “seeing the data”

Need a FULL-SKY Map



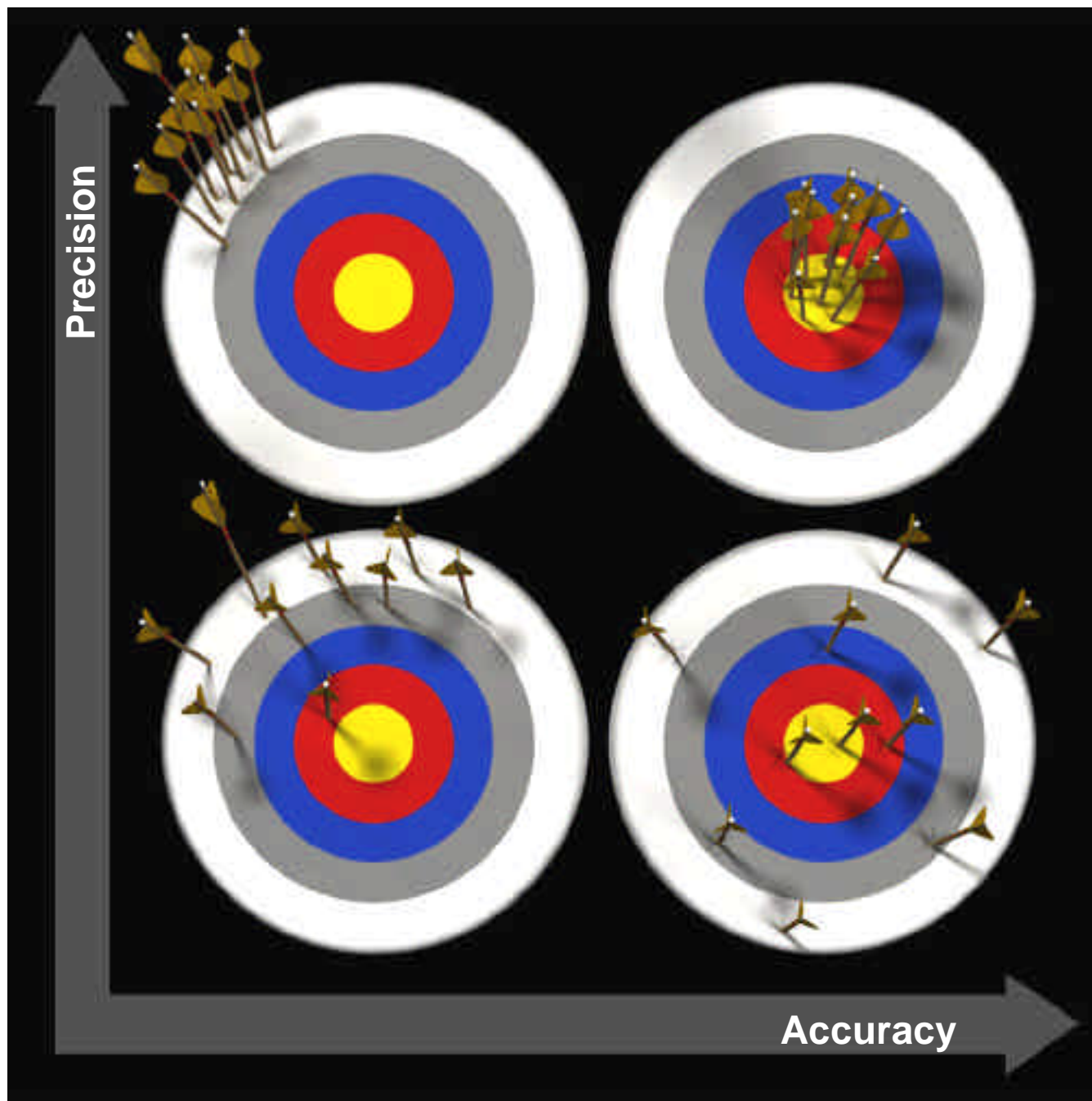
Can't Rule Out Meatball Sky by Current Data!



Systematic Measurement Errors

Every cosmic background experiment ever done has been limited by systematic measurement errors, not by sensitivity.

The driving MAP philosophy is to minimize systematic measurement errors, and to reliably determine their upper limits.



Unprecedented Accuracy and Precision

- **Sky map**

Full sky map, the most complete possible set of observations *

True map (pixel information uncorrelated by instrument) *

Maintain polarization information *

- **Control systematic measurement errors**

Maintain a fully developed error budget *

Symmetric differential observations *

No atmospheric contamination *

No signal emission/reflections from balloon *

In flight amplitude and beam calibration **

Very low side-lobe beam patterns *

Rapid large-sky-area scanning *

Scan full sky multiple times *

Extreme thermal stability with no active controls **

Extreme shielding against Sun, Earth, and Moon signals **

Multiple frequencies near cosmic-to-galactic signal spectral maximum **

Multiple channels **

Multiple signal modulations on diverse time scales *

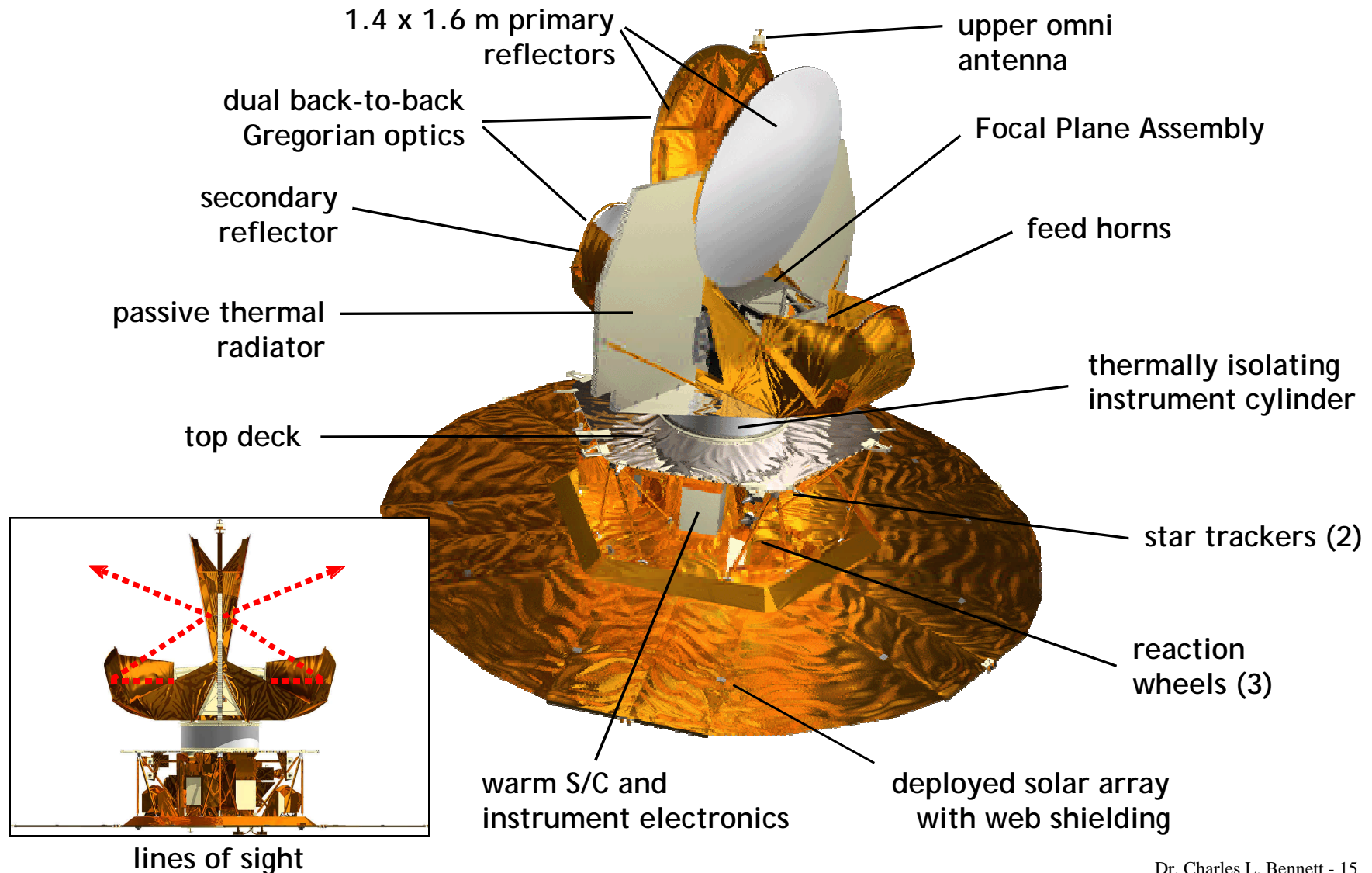
* Like COBE

** Improved from COBE

Accurately Measuring a Part-in-a-Million



MICROWAVE ANISOTROPY PROBE



State-of-the-Art Microwave Receivers

10 "Differencing Assemblies"

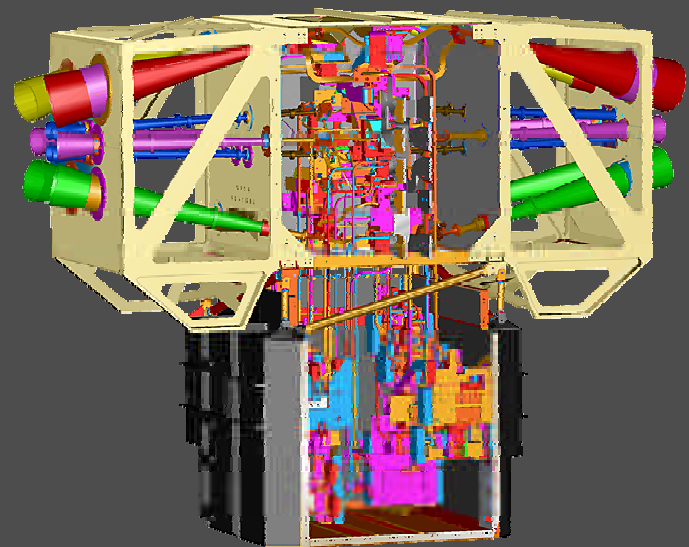
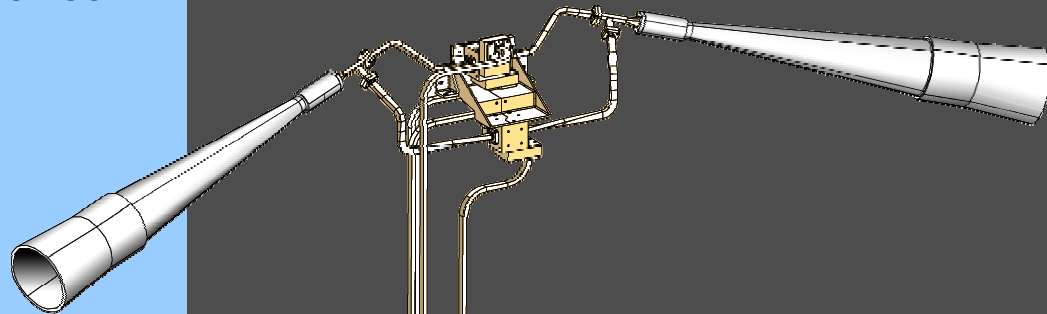
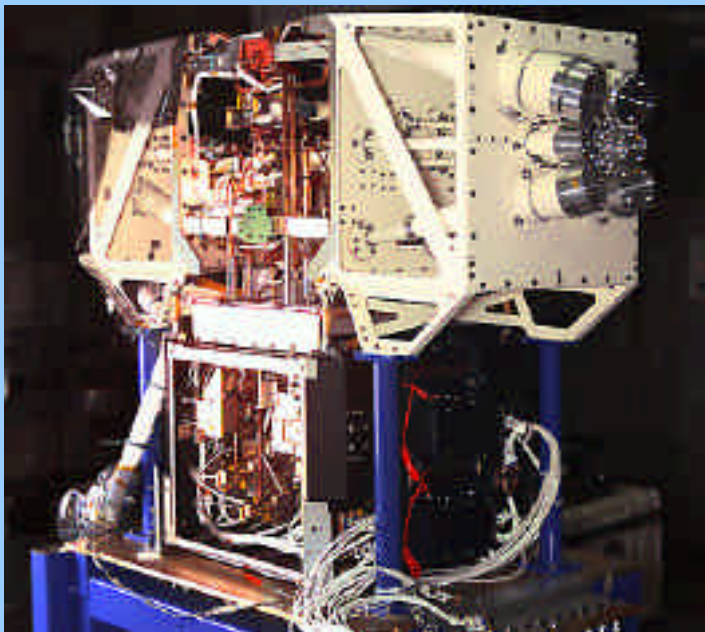
4 @ 90 GHz

2 @ 60 GHz

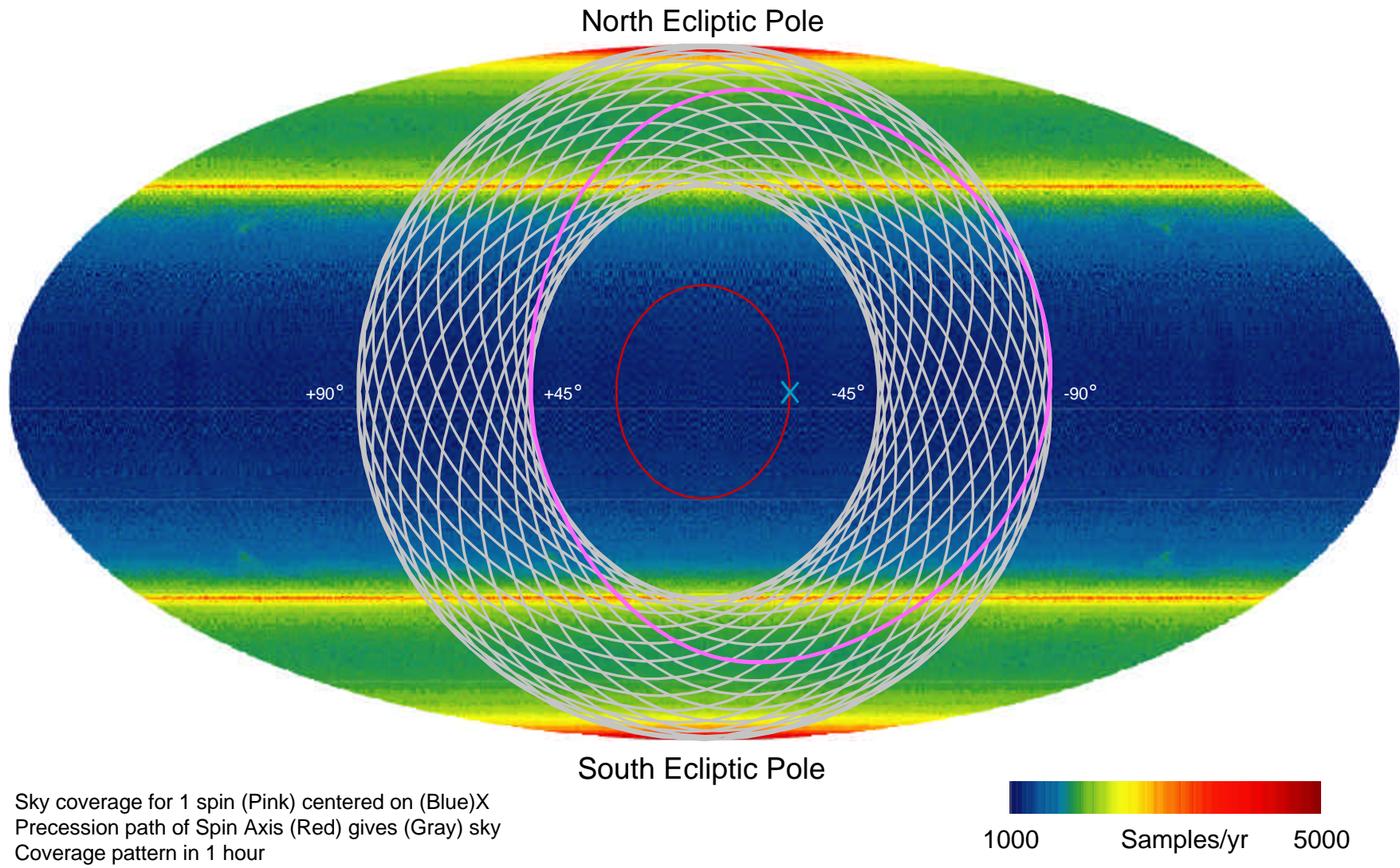
2 @ 40 GHz

1 @ 30 GHz

1 @ 22 GHz



1 Year MAP Sky Coverage



Mission Success Criteria

| CRITERIA | FULL SUCCESS | MINIMUM SUCCESS |
|---|--------------------------------------|---|
| Microwave map sky coverage (nominally 100%) | >95% | >90% |
| Number of Frequency Bands (nominally =5) | _ 4 | _ 3 |
| Error Limits: Systematic Calibration | < 5 μ K < 1 % | < 8 μ K < 2 % |
| Sensitivity / Resolution Combination | Signal-to-Noise > 1 for >0.25° | Cosmology Sample-Variance Limited for >0.5° |

Education and Outreach

TV and Press Coverage of MAP

NOVA "Mapping the Universe" TV show
BBC/Discovery Channel cosmology show
Coverage in Scientific American, Discover, Astronomy, Science, Popular Science, etc.

Web Outreach

Web Site with Public Oriented Presentation
Over 1 million visitors,
1,000 questions/year answered
Multiple Links in MICROSOFT Encarta
Teacher's Guide to Universe

Grade K-12 Outreach

Cooperative Satellite Learning Project Participant
Curriculum Material Designed and Used in New Jersey High Schools (Meets National Standards)
Thousands of Posters and Fact Sheets Distributed

Planetarium Partnership

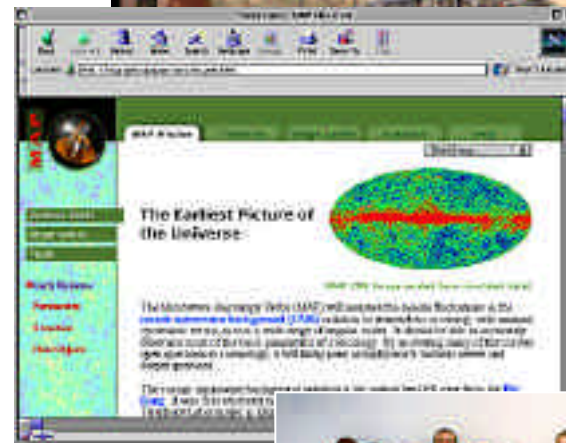
Work Closely with Hayden Planetarium, New York
Helped Develop New Cosmology Exhibits for the Promotion of Science Literacy.

Team Outreach

Numerous Talks to Community and School Groups



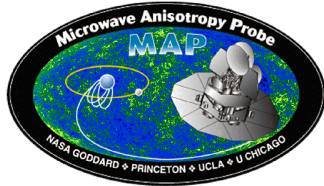
Hayden Planetarium Renovation



Web Site



CSLP Project

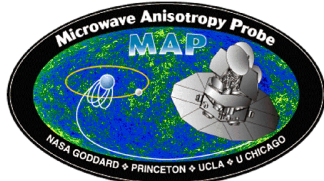


Observatory Readiness

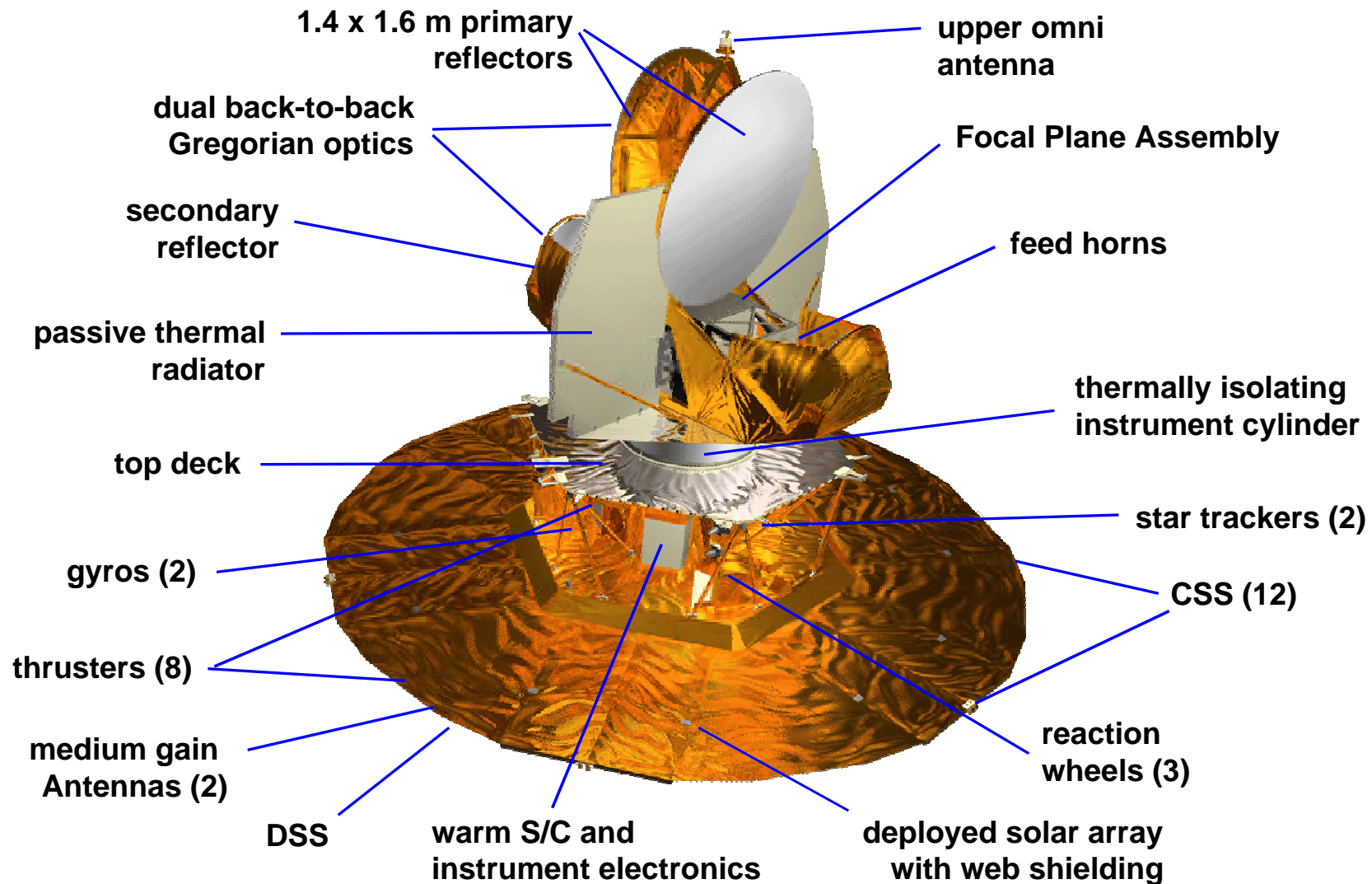
MAP Observatory Readiness

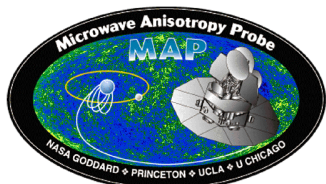
Liz Citrin

MAP Project Manager



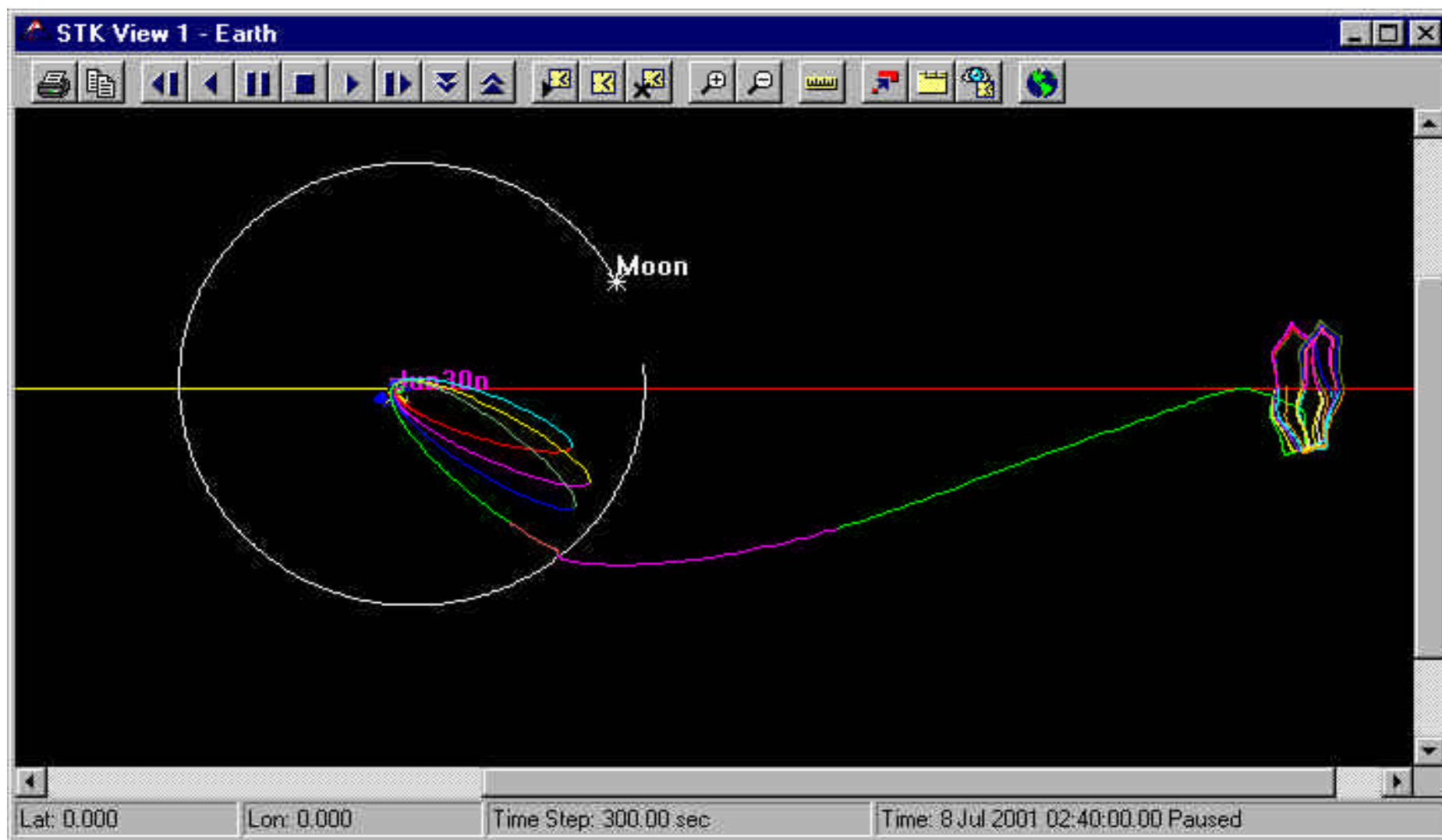
MAP Observatory





MAP Trajectory June 30th Launch

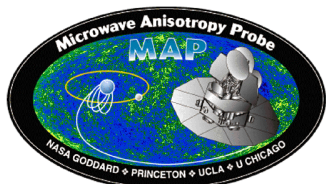
Observatory Readiness





Phasing Loop Animation





MAP Daily Launch Windows

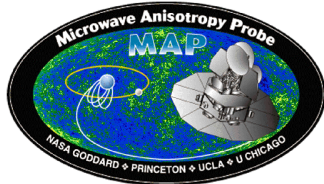
Observatory Readiness

| <u>Launch Date</u> | <u># of min.</u> | <u>Time (EDT)</u> |
|--------------------|------------------|-------------------|
| June 30 | 12 | 3:47 – 3:59 pm |
| July 1 | 12 | 3:40 – 3:52 pm |
| July 2 | 15 | 3:34 – 3:49 pm |
| July 3 | 5 | 3:35 – 3:40 pm |
| * July 4 | 15 | 3:20 – 3:35 pm |
| July 5 | 15 | 3:29 – 3:44 pm |
| July 16 | 10 | 4:24 – 4:34 pm |
| July 17 | 25 | 4:19 – 4:44 pm |
| July 18 | 25 | 4:14 – 4:39 pm |
| July 19 | 20 | 4:15 – 4:35 pm |



The Gantt chart displays the following tasks and their durations:

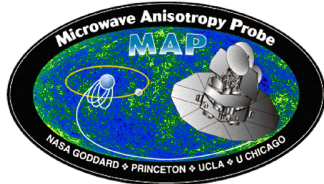
- PRE-ENV CPT** (8/3/00 to 8/18/00)
- INTEGRATE TRS** (8/18/00 to 8/23/00)
- SYSTEM BASELINE ALIGNMENT** (8/23/00 to 9/10/00)
- BLANKET INSTALLATION (EXCEPT SA WEBS)** (9/10/00 to 10/20/00)
- INSTALL FLIGHT ARRAY** (10/20/00 to 11/01/00)
- MASS PROPERTIES/ ADD BALANCE WEIGHT** (11/01/00 to 11/6/00)
- EMC/EMI TESTING** (11/6/00 to 11/20/00)
- MECHANICAL ENVIRONMENTAL TESTS** (11/20/00 to 12/12/00)
- PREPS FOR MOVE TO SES FIX CHAMBER** (12/12/00 to 12/13/00)
- THERMAL VACUUM** (1/6/01 to 1/7/01)
- CHAMBER BREAK INSTALL TRIM RESISTORS** (2/22/01 to 2/23/01)
- THERMAL BALANCE** (3/4/01 to 3/12/01)
- INTEGRATE FLIGHT BATTERY** (3/13/01 to 3/15/01)
- POST-ENV ALIGNMENT** (4/10/01 to 4/17/01)
- POST-ENV FUNCTIONAL** (4/6/01 to 4/9/01)
- SHIPPING PREPS** (4/10/01 to 4/17/01)
- SHIP** (4/17/01 to 4/20/01)
- CONFIGURE IN SAEF-2** (4/20/01 to 4/25/01)
- POST-SHIP CPT** (4/26/01 to 5/1/01)
- INTALL ARRAYS, MISSION SIMS** (5/2/01 to 5/25/01)
- FUEL AND SPIN BALANCE OBSERVATORY IN SAEF 2, MOVE TO PAD** (5/30/01 to 6/11/01)
- PAD OPERATIONS, FUNCTIONAL TESTS** (6/18/01 to 6/30/01)
- LAUNCH WINDOW** (6/30/01 to 7/5/01)



Significant Anomalies

Observatory Readiness

- Pre- and post-environmental alignment measurements showed significant shift in thruster bracket.
 - Thruster bracket blanket was worked after pre-environmental alignment, displacing bracket position.
 - Removed some blanketing and verified structural integrity.
 - Thruster position is in spec.
- Thruster valve thermostats locations allows valves to get too cold.
 - Thermostats were moved during chamber break and verified in Thermal Balance.
- Thruster bracket thermostat setpoints were incorrect.
 - Thermostats were replaced during chamber break and verified in Thermal Balance.



Significant Anomalies (2)

Observatory Readiness

- Fill and Drain valve heater size was inadequate.
 - Additional heater was added during the chamber break and verified in Thermal Balance.
- AST1 survival heater failed to actuate.
 - High probability that heater circuit was damaged during Interpoint repair prior observatory integration.
 - Heater will not be repaired.
 - AST1 will remain powered in survival scenarios.
- Reaction Wheel heaters are too small in survival mode.
 - Test heaters (flight quality) used during thermal test were wired into the reaction wheel heater circuits.
 - Heater circuits were verified end-to-end after rework.



```

graph LR
    subgraph Row1
        R1_1["Install Solar Arrays  
5/13/01 - 5/26/01"] --> R1_2["Schedule Slack (2 days)  
5/27/01 - 5/28/01"]
        R1_2 --> R1_3["Propellant Loading  
5/29/01 - 6/1/01"]
        R1_3 --> R1_4["Spin Balance  
6/2/01 - 6/4/01"]
        R1_4 --> R1_5["Schedule Slack (3 days)  
6/5/01 - 6/7/01"]
    end
    subgraph Row2
        R2_1["Instrument Burn-in and Procedure Test  
6/9/01 - 6/12/01"] --> R2_2["Mate to 3rd Stage  
6/13/01 - 6/14/01"]
        R2_2 --> R2_3["Recondition Battery  
6/15/01 - 6/17/01"]
        R2_3 --> R2_4["Transport to PAD  
6/19/01 - 6/20/01"]
        R2_4 --> R2_5["Battery Charging  
6/20/01 - 6/21/01"]
    end
    subgraph Row3
        R3_1["Pre-Fairing Functional, Inst. Burn-in  
6/22/01 - 6/25/01"] --> R3_2["Fairing Installation  
6/26/01 - 6/27/01"]
        R3_2 --> R3_3["Post-Fairing Functional Test  
6/27/01 - 6/28/01"]
        R3_3 --> R3_4["2nd Stage Propellant Loading  
6/28/01 - 6/29/01"]
        R3_4 --> R3_5["Beacon, Range Safety, & Ordnance  
6/29/01 - 6/30/01"]
    end
    R3_5 --> R4_1["Launch  
6/30/01"]
  
```

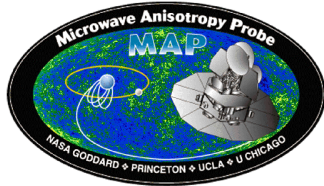


Observatory Readiness

- Observatory Readiness**



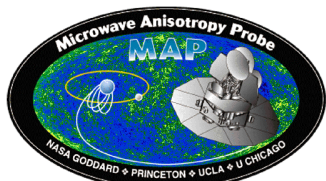
- Remaining work is planned and in schedule
- On track for June 30 launch



Ground System & Operations

Ground Systems & Operations

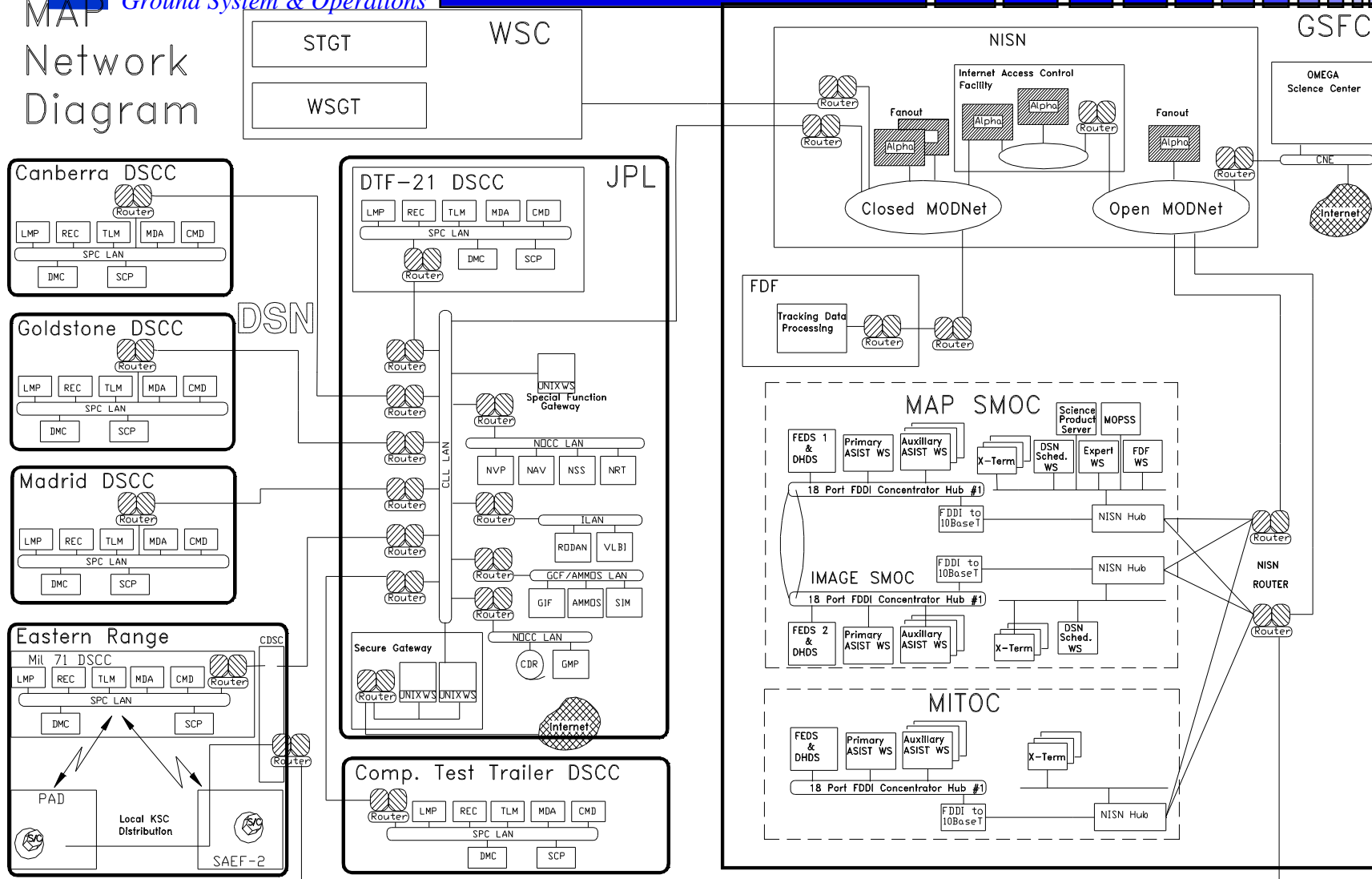
Steven Coyle

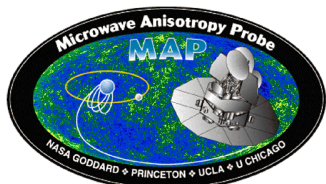


MAP Data Network

MAP Ground System & Operations

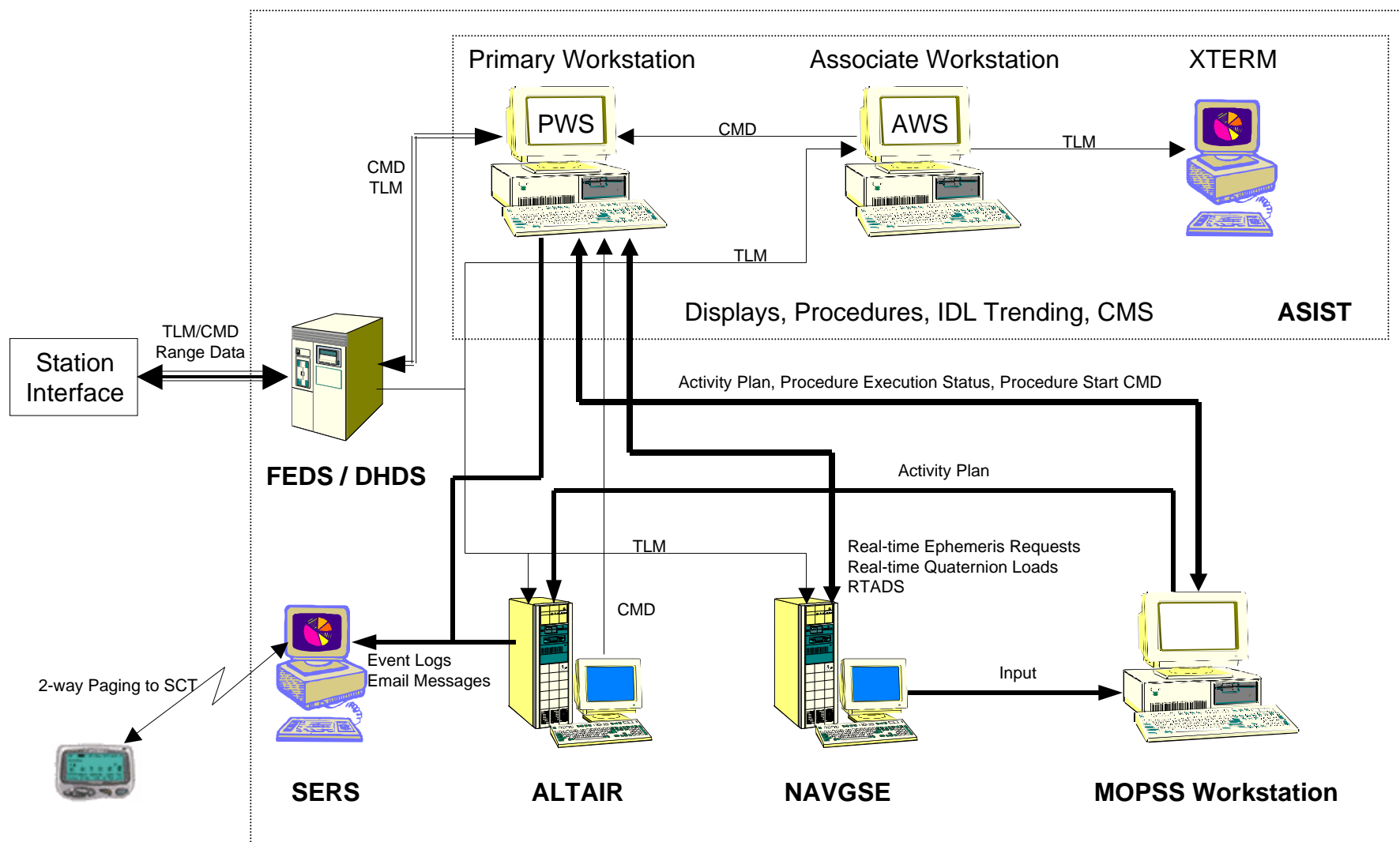
Network Diagram

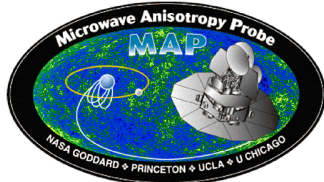




Combined Ground System Diagram

Ground System & Operations

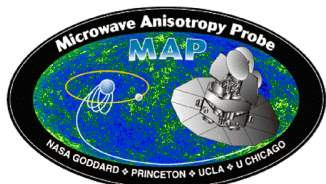




Mission Operations Status

Ground System & Operations

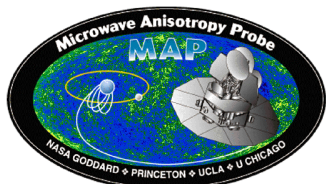
| Element | Status |
|---|--|
| Flight Software Maintenance | Ready |
| Science Operation & Data Processing | Ready |
| Ground System | Ready |
| Launch and IOC Ops Preps | Launch & IOC Timelines and scripts are complete. Procedure testing in progress. |
| Networks | DSN: Ready , ORT testing continues. TDRSS: Ready , Mila Relay testing continues |
| Trajectory and Navigation | Ready |
| Planning, Trending and L0 Processing | Ready |
| Training and Sim Preps of Ops Personnel | Ready Mission simulations continuing (31 of 43 completed) |



Operational Procedure Status



| | Procedures needing to be tested | Procedures complete and tested | Totals |
|---------------------------|---------------------------------------|--------------------------------------|--------|
| Operational Procedures | 26 | 90 | 116 |
| Contingency Procedures | 7 | 52 | 59 |



Observatory Level Box Runtime

Ground System & Operations

| Component | hhhh:mm | Component | hhhh:mm |
|---------------|---------|-----------|---------|
| PSE | 4168:07 | DSS | 1950:22 |
| MAC | 4067:26 | ISO-VALVE | 208:25 |
| XPNDR A (RCV) | 3966:08 | TARA1 | 1908:17 |
| XMITTER A | 1167:21 | TARA2 | 1919:28 |
| XPNDR B (RCV) | 3963:31 | INST | 1104:23 |
| XMITTER B | 393:52 | RWA1 | 1854:15 |
| LMAC | 3721:33 | RWA2 | 1812:33 |
| ST1 | 1115:58 | RWA3 | 1787:41 |
| ST2 | 1063:15 | | |

As of May 5,2001

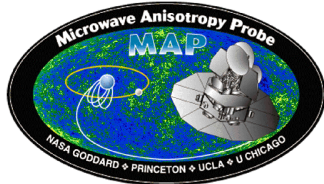


- **Spacecraft**

- Successful PAD functional test
- Observatory is in launch configuration and state-of-health verified through telemetry
- Battery state of charge sufficient to handle worst case launch, ascent and acquisition sequence

- **Instrument**

- Successful Pad functional test
 - The instrument is not powered at launch
- Amplifier burn-in sufficient to meet sensitivity requirement



Launch Commit Criteria (2)



Ground System & Operations

- **Ground System**

- **SMOC**

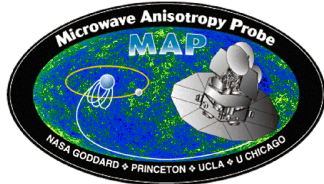
- Must be able to process telemetry and execute commands to maintain the observatory in a safe operational mode

- **SAEF-2 (Room 201) and Blockhouse**

- Must be able to process telemetry and execute commands to maintain the observatory in a safe operational mode
 - Must be able to provide S/C power prior to launch and transition to internal power

- **MMFD (FDF)**

- Must be prepared to preprocess DSN tracking data and deliver the data to the SMOC



Launch Commit Criteria (3)

Ground System & Operations

- **Network**

- **Deep Space Network**

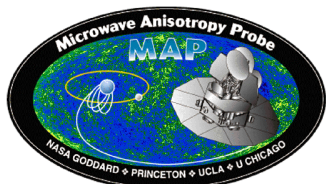
- Goldstone & Madrid must report in “Green” with at least one station calibrated and operational to support MAP

- **TDRSS**

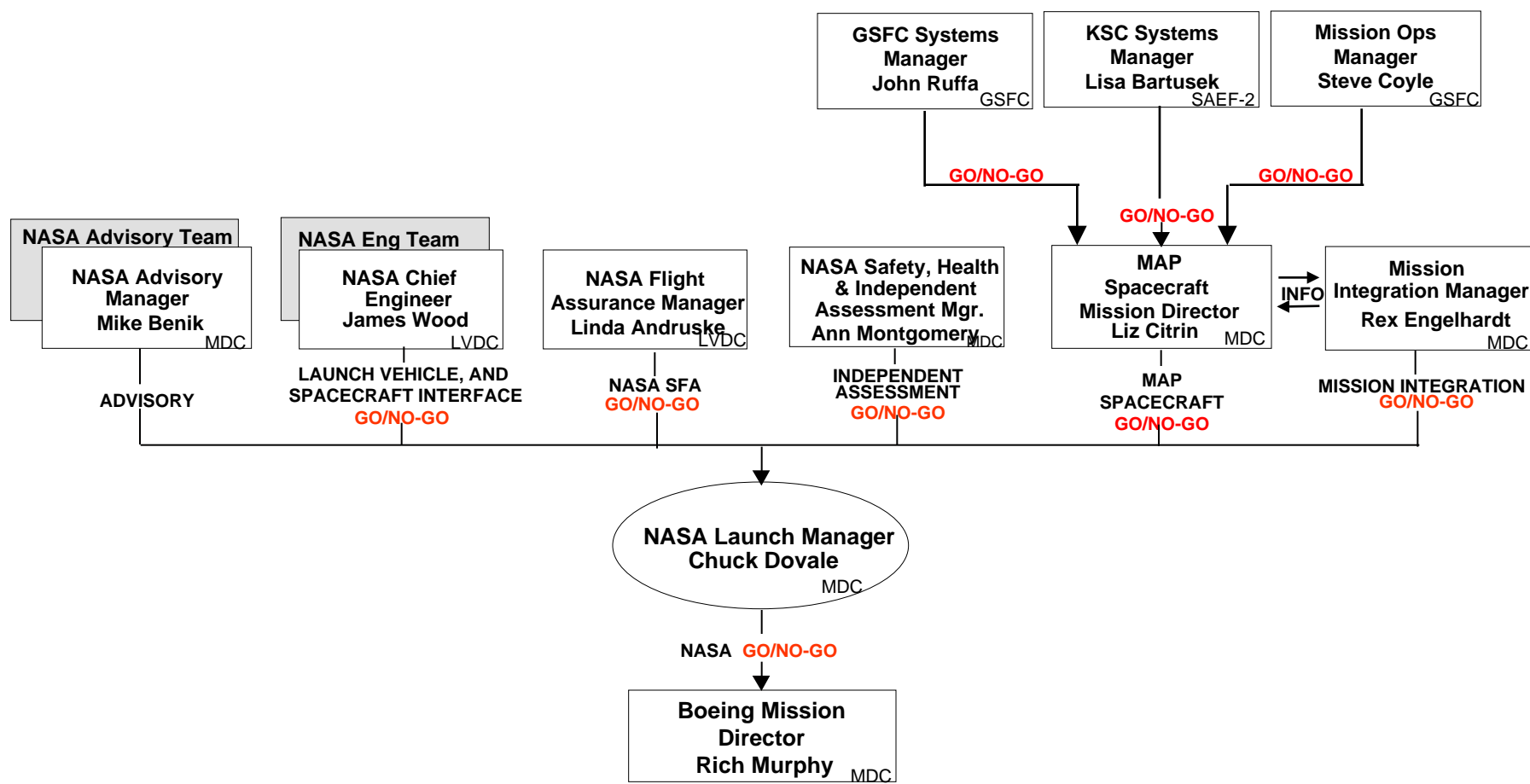
- Configured to provide telemetry and command support following spacecraft separation from the launch vehicle

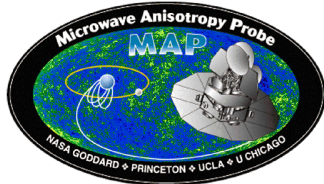
- **NASCOM**

- Voice and data circuits must be operational between the SMOC, SAEF-2, SLC-17, TDRSS and the DSN



Launch Day Management Flow





Launch Countdown Summary

Power-On Shift

Ground System & Operations

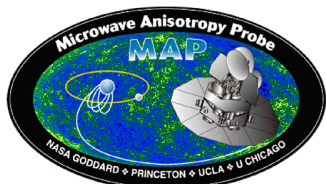
| Planned Activity for Nominal Launch - June 30, 2001 | GMT (hh:mm:ss) | EDT (hh:mm:ss) | L- Time (hh:mm) | T-Time (hh:mm) |
|--|-------------------|-------------------|--------------------|-------------------|
| Configure & verify MAP Ground Segment for Launch Operations | 7:56:46 | 3:56:46 | 11:50 | 10:40 |
| Call To Station: Remainder of Spacecraft Power-On Team | 9:16:46 | 5:16:46 | 10:30 | 9:20 |
| Proceed with Power-On of Spacecraft | 9:46:46 | 5:46:46 | 10:00 | 8:50 |
| ** MST Preparations and Move | 9:49:46 | 5:49:46 | 9:57 | 8:47 |
| GSFC Sys: Handover Primary Control of Spacecraft to GSFC | 10:21:46 | 6:21:46 | 9:25 | 8:15 |
| Proceed with Power-On of Instrument | 11:16:46 | 7:16:46 | 8:30 | 7:20 |
| Load/verify ACS Tables 48, 51 & 54 | 11:31:46 | 7:31:46 | 8:15 | 7:05 |
| Load/verify RTSs 30, 31 & 150 | 11:41:46 | 7:41:46 | 8:05 | 6:55 |
| Load/verify Launch Day Ephemeris | 11:51:46 | 7:51:46 | 7:55 | 6:45 |
| ** MST move completed | 12:49:46 | 8:49:46 | 6:57 | 5:47 |
| Configure MV TSMs & ACS FDCs to Launch Configuration | 12:56:46 | 8:56:46 | 6:50 | 5:40 |
| Configure RTSs to Launch Configuration | 13:26:46 | 9:26:46 | 6:20 | 5:10 |
| ** Final Mission Assurance COLA Decision to Boeing | 13:46:46 | 9:46:46 | 6:00 | 4:50 |
| Initiate Playback of VRs | 13:46:46 | 9:46:46 | 6:00 | 4:50 |
| Set PSE Wheel Timer | 15:21:46 | 11:21:46 | 4:25 | 3:15 |
| Turn Off Instrument for Launch | 15:26:46 | 11:26:46 | 4:20 | 3:10 |
| Complete Configuration to Basic Launch Configuration | 15:31:46 | 11:31:46 | 4:15 | 3:05 |
| Basic MAP Launch Configuration Complete | 15:36:46 | 11:36:46 | 4:10 | 3:00 |
| Start of Shift Handover: Power-On to Launch | 15:46:46 | 11:46:46 | 4:00 | 2:30 |
| ** Start of T-150 (60 minute) Built in Hold | 16:06:46 | 12:06:46 | 3:40 | 2:30 |
| Call To Station for Shift Handover: Spacecraft Launch Team | 16:16:46 | 12:16:46 | 3:30 | 2:30 |
| ** Final Manned Conjunctions to Boeing/NASA Launch Team | 16:46:46 | 12:46:46 | 3:00 | 2:30 |
| MAP PM Polls MAP KSC/GSFC to "GO" for Initial Terminal Count | 16:46:46 | 12:46:46 | 3:00 | 2:30 |
| *** NLM Polls MAP PM to "GO" for Initial Terminal Count | 16:51:46 | 12:51:46 | 2:55 | 2:30 |

Launch Countdown Summary

Launch Shift

Ground System & Operations

| Planned Activity for Nominal Launch - June 30, 2001 | GMT (hh:mm:ss) | EDT (hh:mm:ss) | L- Time (hh:mm) | T-Time (hh:mm) |
|--|-------------------|-------------------|--------------------|-------------------|
| ** Last access to Umbilical Console | 17:06:46 | 13:06:46 | 2:40 | 2:30 |
| ** End of 60 minute Built in Hold | 17:06:46 | 13:06:46 | 2:40 | 2:30 |
| Shift handover complete | 17:06:46 | 13:06:46 | 2:40 | 2:30 |
| Select TDRS Filter Tbl & Command to 2k Downlink | 17:36:46 | 13:36:46 | 2:10 | 2:00 |
| MAP PM Polls MAP KSC/GSFC to "GO" for Cryo Loading | 17:56:46 | 13:56:46 | 1:50 | 1:40 |
| ** Weather Briefing | 18:01:46 | 14:01:46 | 1:45 | 1:35 |
| ** Winds Assessment Briefing | 18:06:46 | 14:06:46 | 1:40 | 1:30 |
| *** NLM Polls MAP PM to "GO" for Cryo Loading | 18:09:45 | 14:09:46 | 1:37 | 1:27 |
| ** Begin LOX loading | 18:21:46 | 14:21:46 | 1:25 | 1:15 |
| ** Weather Update | 18:57:46 | 14:57:46 | 0:49 | 0:39 |
| ** Winds Assessment Update | 19:03:46 | 15:03:46 | 0:43 | 0:33 |
| Start RTS 150 & Enable PSE Wheel Timer | 19:16:46 | 15:16:46 | 0:30 | 0:20 |
| ** Range Status Update | 19:21:46 | 15:21:46 | 0:25 | 0:15 |
| ** Winds Assessment Update | 19:24:46 | 15:24:46 | 0:22 | 0:12 |
| MAP PM Polls MAP KSC/GSFC to "GO" for Final Launch Prep | 19:26:46 | 15:26:46 | 0:20 | 0:10 |
| *** NLM Polls MAP PM to "GO" for Final Launch Prep | 19:28:46 | 15:28:46 | 0:18 | 0:08 |
| ** Start of 10 minute Built in Hold | 19:32:46 | 15:32:46 | 0:14 | 0:04 |
| MAP PM Polls MAP KSC/GSFC for "GO/NOGO" for Launch | 19:34:46 | 15:34:46 | 0:12 | 0:04 |
| *** NLM Polls MAP PM for "GO/NOGO" for Launch | 19:36:46 | 15:36:46 | 0:10 | 0:04 |
| ** LCDR to proceed with countdown at the end of the 10 minute hold | 19:41:46 | 15:41:46 | 0:05 | 0:04 |
| SAS Off - MAP on Internal Power | 19:41:46 | 15:41:46 | 0:05 | 0:04 |
| ** End of 10 minute Built in Hold | 19:42:46 | 15:42:46 | 0:04 | 0:04 |
| Launch Window Open | 19:46:46 | 15:46:46 | 0:00 | 0:00 |
| ** "Lift - Off" | 19:46:46 | 15:46:46 | 0:00 | 0:00 |
| Launch Window Close | 19:56:46 | 15:56:46 | 0:00 | 0:00 |



Delta-II Ascent

Ground System & Operations

| Launch Sequence | | |
|-----------------|-------------|---|
| MET (sec) | L+TIME | Activity Description |
| 0.000 | L + 0:00:00 | LAUNCH |
| 696.428 | L + 0:11:36 | First Cutoff - Stage II (SECO 1) |
| 2936.000 | L + 0:48:56 | MAP in view of TDRS West |
| 4532.000 | L + 1:15:32 | MAP Transmitter Turn ON |
| 4663.038 | L + 1:17:43 | First Restart - Stage II |
| 4667.214 | L + 1:17:47 | Second Engine Cut Off - Stage II (SECO 2) |
| 4717.214 | L + 1:18:37 | Fire Spin Rockets |
| 4720.214 | L + 1:18:40 | Jettison Stage II |
| 4757.214 | L + 1:19:17 | Stage III Ignition |
| 4845.010 | L + 1:20:45 | Stage III Burn Out |
| 5127.214 | L + 1:25:27 | Initiate Yo-Yo Despin |
| 5132.214 | L + 1:25:32 | Jettison Stage III - MAP SEPARATION |
| 7232.000 | L + 2:00:32 | MAP Power Positive |
| 7352.000 | L + 2:02:32 | MAP Stable on the Sunline |



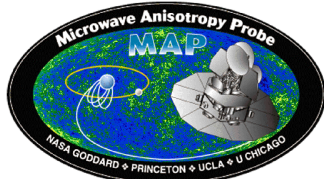
| <u>Event</u> | <u>Time</u> | <u>UTC</u> | <u>Notes</u> |
|----------------------------|----------------|--------------|------------------------------------|
| Launch | L | 6/30@19:46 | For June 30, 2001 |
| 3 rd Stage Burn | L + 70 min | 20:66:45 | Long coast |
| Separation | TTI + 5 min | 21:16:54 | SA deploy right after separation |
| Cal burns | L + 2 days | | ASAP (Cal Thrustres 5-8 before A1) |
| A1 | L + 3.5 days | | Mnvr only if perigee too low |
| P1 | L + 7 days | | Incr sma to lunar dist |
| A2 | L + 12 days | | No mnvr planned |
| P2 | L + 17 days | | No mnvr planned |
| A3 | L + 22 days | | No mnvr planned |
| P3 | L + 27 days | | Dv req'd |
| Swingby | L + 30 days | 7/30 @ 23:28 | No mnvr |
| MCC | S + 7 days | | Current Baseline |
| L2 Insertion | S + 120 days | 12/26@22:55 | No mnvr |
| Stationkeeping | Every 3 months | | |
| | | | |



```
graph TD; PI["Principle Investigator  
Chuck Bennett"] --- ST["Science Team/  
OMEGA"]; PI --- BM["Business Manager"]; PI --- C44["Code 444  
MOM  
Steven Coyle"]; C44 --- SET["Systems Eng  
Team"]; C44 --- SOT["Science Ops Team  
Gary Hinshaw  
Ops Scientist"]; C44 --- SCL["SCT Lead  
Judy Pepoy"]; C44 --- MT["Maneuver Team  
Lead  
Steven Andrews"]; C44 --- SSC["S/C Subsystems  
Engineering Leads"]; C44 --- GSD["Ground System  
DevelopmentLead  
Jim Dowling"]; C44 --- FSW["Flight S/W Maint/Flatsat  
Lead  
Jane Marquart"]; MT --- PL["Propulsion Lead  
Gary Davis"]; MT --- NT["Navigation Team  
Lead  
Os Cuevas"];
```

The organizational chart for the Mars Science Laboratory Mission (MSLM) is structured as follows:

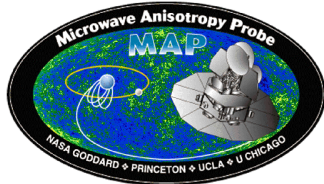
- Principle Investigator**
Chuck Bennett
 - Science Team/OMEGA**
 - Business Manager**
 - Code 444 MOM**
Steven Coyle
 - Systems Eng Team**
 - Science Ops Team**
Gary Hinshaw
Ops Scientist
 - SCT Lead**
Judy Pepoy
 - Maneuver Team Lead**
Steven Andrews
 - Propulsion Lead**
Gary Davis
 - Navigation Team Lead**
Os Cuevas
 - S/C Subsystems Engineering Leads**
 - Ground System DevelopmentLead**
Jim Dowling
 - Flight S/W Maint/Flatsat Lead**
Jane Marquart



Staffing and Operations Ground System & Facilities

Staffing Overview

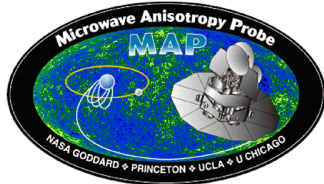
| Mission Day | Pre-Launch | | IOC | | | | Cruise | | L2 Ops | |
|-------------|--|---|---|--|--|--|---|--|---|-------------------------------|
| | L-12 | L+0 | L+0 | | | L+34 | L+35 | L+90 | L+91 | EOL |
| | | | IOC Ops L+0 | Manuever Ops L+7 | Nominal Pass Ops L+7 | Special Ops L+34 - Mid-Course Corrections | Nominal Pass Ops L+35 | L+90 | Normal Routine Operations with Automation Tested | Delta-V Operations |
| SMOC | - Primary Control Site | - Primary Control Site | - Primary Control Site | - Primary Control Site | - Primary Control Site | - Primary Control Site | - Primary Control Site | - Primary Control Site | - Primary Control Site | - Primary Control Site |
| | - SCT 24 hours/day | - SCT 24 hours/day | - SCT 24 hours/day | - SCT 24 hours/day | - SCT 24 hours/day | - SCT 24 hours/day | - SCT 24 hours/day | - SCT Day/Swing Shift | - SCT Day Shift | - SCT 2 Shifts |
| | - System Support All Pad Testing | - System Support 24/day | - System Support 24/day | - System Support 24/day | - System Support 12/day | - System Support 12/day | - System Support 12/day | - System Support as needed | - System Support as needed | - System Support as needed |
| | - Subsystem Support All Pad Testing | - All Subsystems Support 24/day | - Subsystem Support ASC/FSW/Prop 24/day Others: 12/day | - Subsystem Support ASC/FSW Day/Swing Shift Others: Day Shift | - Subsystem Support ASC/FSW Day/Swing Shift Others: Day Shift | - Subsystem Support ASC/FSW/Prop 12/day Others: as needed | - Subsystem Support as needed | - Subsystem Support as needed | - Subsystem Support ASC/FSW/Prop 12/day | |
| | - Maneuver Team Day Shift off-line analysis | - Maneuver Team 24/day off-line analysis | - Maneuver Team 24/day off-line analysis | - Maneuver Team Day/Swing Shift off-line analysis | - Maneuver Team Day/Swing Shift off-line analysis | - Maneuver Team 12/day off-line analysis | - Maneuver Team Day Shift off-line analysis | - Maneuver Team One Day/Week off-line analysis | - Maneuver Team 12/day off-line analysis | |
| MITOC | - 2nd Backup Control | - 2nd Backup Control | - 2nd Backup Control | - 2nd Backup Control | - Backup Control Site | | | | | |
| | - 4 Instr Controllers & Science Team All Pad Testing | - 4 Instr Controllers & Science Team 24/day | - 4 Instr Controllers & Science Team 12/day | - 4 Instr Controllers & Science Team Day Shift | | | | | | |
| | - GS Developers Day Shift | - GS Developers Day Shift | - GS Developers Day Shift | - GS Developers Day Shift | | | | | | |
| CAPE | - 3rd Backup Control | | | | | | | | | |
| | - SCT 24/Day | | | | | | | | | |
| | - Power & Systems for all Pad Testing – on call at other times | | | | | | | | | |
| Block House | 2 people 24/Day | | | | | | | | | |



Readiness



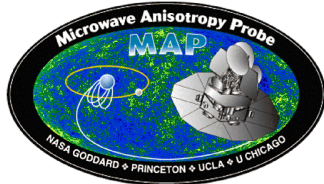
- Ground System and Operations will be **Ready** for launch



Ground System and Operations

Ground System & Operations

Backup Slides



Ground System Status

Ground System & Operations

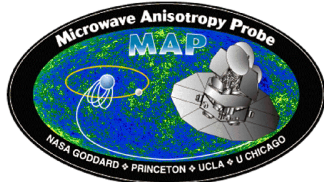
- Common Ground System that is Operational in the IMAGE and EO-1 control centers
- Running ASIST Release 9.0f
 - Launch Release, Delivered 2/15/01
 - No Launch Critical UPR's outstanding
 - No Project level PFR's
- Ground System is Frozen L-60 days
 - April 30, 2001



Mission Simulations

Ground System & Operations

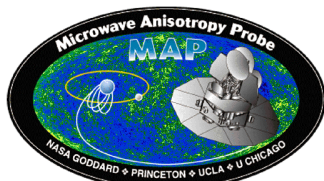
| Mission Sim | Date | Status | WOA / PRs Open | Platform | Script Lead / Contingency Lead | Scope | Results |
|-------------|--------------------|----------|----------------------|----------|--------------------------------|---|---|
| 4a | 03/29/01 | Complete | | Flatsat | S. Andrews | P1 Maneuver | No Script available, CM questions with maneuver data, Ground System Redundancy not available, Perigee Maneuver Proc could not be restarted, TSM Proc runs too slow at 2K, Burn Executed Nominally |
| 6 | 4/8/2001, Pre-Ship | Complete | 1899 | S/C | S. Glockner | Launch and Acq. Repeat Mission Sim 3' from 3/23/01 | Successfully Recovered from Failed MV and HRSN. Discovered Safehold will drive S/C to sun with Arrays Stowed. Power survived with Failed PWM. Launch Proc needs specific PSE Wheel timer commanded. |
| 4b | 04/13/01 | Complete | 1913, No PRs Written | Flatsat | S. Andrews | PFinal Maneuver - ACS Contingency | Preps ATS byte swapped, again; time not correlated between workstations; delta V proc executes slow, TSMRTS slow, PSE tm failure hows EVD power should always remain on. UPS tripped off due to faulty power strip 5 minutes prior to burn. Warning for the S |
| 6a | April 17&18, 2001 | Complete | | Flatsat | B. Twambly | Maneuver Proficiency & Contingency. Sim Maneuver Process(Traj, Hi Fi, Flatsat Ver, Flatsat Sim) in Real Time. | Reran the Pf maneuver wit a failed thruster. Found that partial table load proc overwrites MV memory if the current value table is not up to date. Table load needs to be fixed. Found that Flatsat, S/C and Navgse are not using a consistent S/C Mass. |
| 5c | April 19&20, 2001 | | | Flatsat | S. Glockner & B. Twambly | 1) Separation, IOC & Cal Burns, 2) Maneuver | |
| | 05/02/01 | Complete | | S/C | J. McCabe & M. Bay | Contingency Procedure Checkout | |



Mission Simulations

Ground System & Operations

| Mission Sim | Date | Status | WOA / PRs Open | Platform | Script Lead / Contingency Lead | Scope | Results |
|-------------|---------------------|----------|----------------|----------|--------------------------------|--|---|
| 7 | 05/04/01, Post-Ship | Complete | 1934/23 Open | S/C | S. Glockner & B. Twambly | Launch, Check end-to-end via Mil-71, TDRS & DSN --> Deploy & Contingency, | Many problems with voice loops and protocol for using loops. Ran into table dump problem again. Time not synced across workstations yet again. Need a working countdown clock. Numerous procedure mods. Need to resolve how to manage and keep the flight table |
| 2f | 05/05/01 | Complete | 1937/ | Flatsat | S. Andrews | Mid-Course Correction | Set up automated burn with built in stop rts. Ground disable the stop RTS 181. Move filter table changes before spin down. Modify Stored Cmd generation to print with actual GMT times. Modify the procedure to add a commented abort burn RTS12 command to all |
| | 05/07/01 | Complete | 1939/ | S/C | D. Ward | Maneuver with Spacecraft (2 to 5 sec). Place S/C into mission mode, simulate the sequence leading up to the maneuver especially the power subsystem and Solar Array. | |
| 7a | May 8&9, 2001 | | | Flatsat | S. Glockner & B. Twambly | Paper Simulation Apogee to P1 Maneuver, P1 to L2 | |
| 8a | May 14&15, 2001 | | | Flatsat | B. Twambly | Sep and Acquisition, Launch to Apogee Maneuver Proficiency & Contingency | |
| 8a | 05/16/01 | | | Flatsat | B. Twambly | Apogee Maneuver | |



Mission Simulations

Ground System & Operations

| Mission Sim | Date | Status | WOA / PRs Open | Platform | Script Lead / Contingency Lead | Scope | Results |
|-------------|------------------------------------|--------|----------------|----------|--------------------------------|---|---------|
| | 05/19/01, Deploy | | | S/C | S. Glockner | Launch, Verify Umbilical Demate at simulated | |
| 8 | 05/23/01, Pre-Stacking TDRS & Mila | | | S/C | S. Glockner | Launch, End To End through MILA | |
| | 06/04/01 | | | Flatsat | S. Glockner & B. Twambly | Launch & Contingency, Maneuver w/ failed RWA | |
| | 06/08/01 | | | S/C | S. Glockner & B. Twambly | Normal Ops through MIL-71, Practice Loss of Comm Paths | |
| | 06/09/01 | | | S/C | S. Glockner & B. Twambly | Normal Ops through MIL-71, Practice Loss of Comm Paths | |
| | 06/11/01 | | | Flatsat | S. Glockner & B. Twambly | Launch & Contingency, Maneuver | |
| | 06/12/01 | | | S/C | S. Glockner & B. Twambly | Launch Scrub and Battery Recharge | |
| | 06/18/01 | | | Flatsat | S. Glockner & B. Twambly | Launch & Contingency, Maneuver | |
| | Add this in June | | | | S. Glockner & B. Twambly | L2 Momentum Unload, Work Procedure to stop spin and precess Z axis to burn attitude without violating 20 to 25 deg cone | |
| | 06/22/01, T-6 | | | S/C | S. Glockner & B. Twambly | Demonstration: Launch & Contingency, Table Dumps for MV Tables | |
| | 06/28/01 | | | | | Rehearsal (Paper & Voice) | |



Spacecraft Mission Readiness Review



KSC ELV Project Office Presentation

Rex Engelhardt

22 May 01



Agenda

Mission Overview

Schedule, Range & Launch Site Status

Mission Unique Items

Launch Vehicle Status

Communication, TM and Tracking

Readiness

Backup



Mission Overview



John F. Kennedy Space Center

MAP Mission Requirements

EXPENDABLE LAUNCH VEHICLES

- **Launch Vehicle Configuration** **Delta II 7425 - 10**
- **Launch Site** **ER SLC-17**
- **Spacecraft Mass** **835 kg (1840.86 lb)**
- **Launch Period** **30 June - 17 Sept 2001**
- **Single Daily Launch Attempt:**
 - **Flight Azimuth** **95 deg**
- **Second Stage Probability of Command Shutdown (PCS)** **$\geq 99.865\%$**
- **Free Molecular Heating Rate at Fairing Separation** **≤ 0.1 BTU/ft²/sec**
- **Thermal Roll during Coast after SECO-1** **Yes**
- **Spin Rates:**
 - **During Third Stage Operation** **60 ± 9.0 rpm**
 - **Spacecraft after Sep and Propellant Spin-down** **0 ± 2.0 rpm**



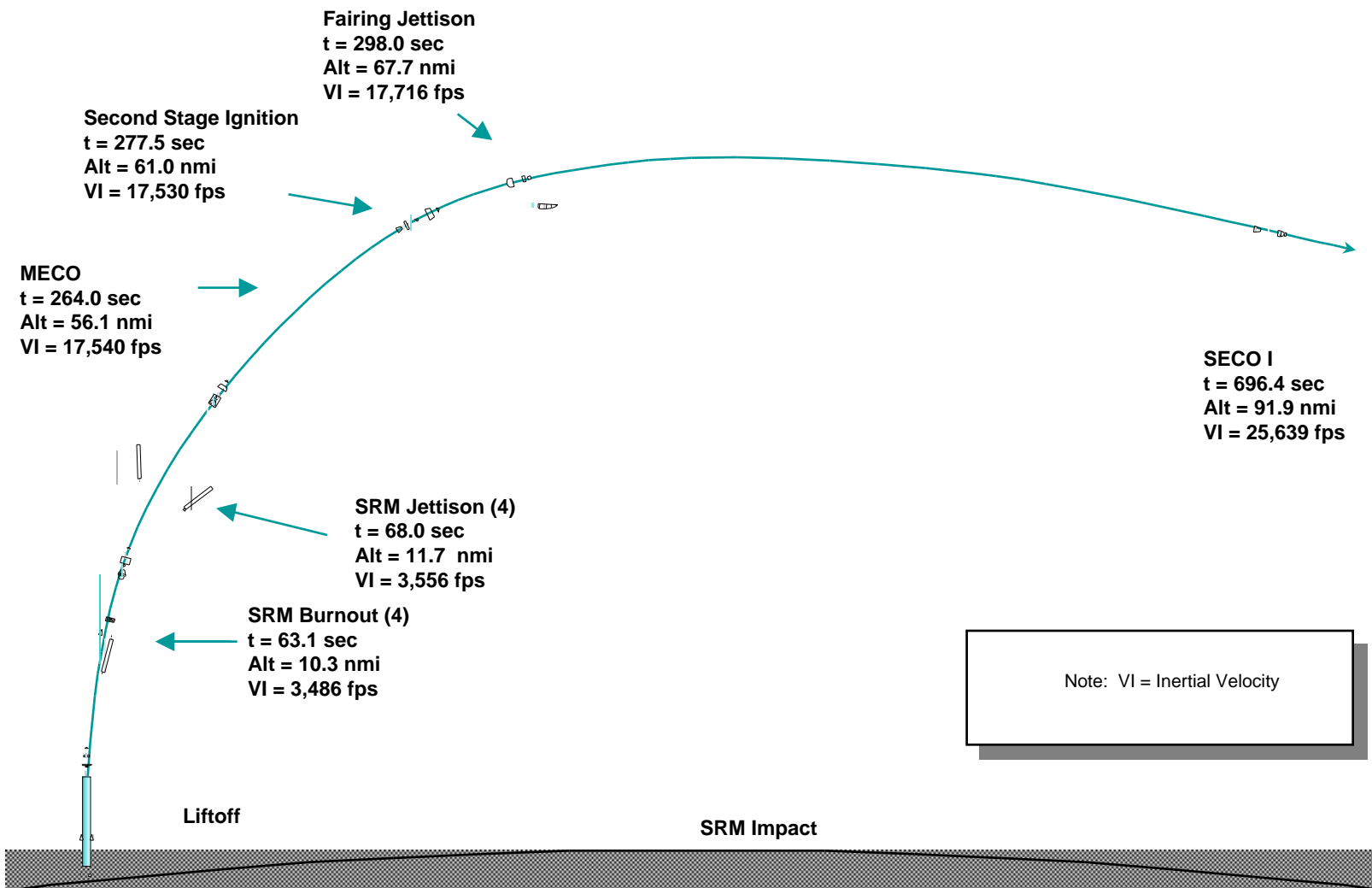
MAP Spacecraft Mission Launch Windows

John F. Kennedy Space Center

EXPENDABLE LAUNCH VEHICLES

| <u>Launch Date</u> | <u>Open (UTC)</u> <u>(hh:mm:ss)</u> | <u>Close (UTC)</u> <u>(hh:mm:ss)</u> | <u>Open (EDT)</u> <u>(hh:mm:ss)</u> | <u>Close (EDT)</u> <u>(hh:mm:ss)</u> | <u>Duration</u> <u>(min)</u> |
|--------------------|--|---|--|---|---------------------------------|
| 30 June 2001 | 19:46:46 | 19:56:46 | 15:46:46 | 15:56:46 | 10 |
| 01 July 2001 | 19:40:10 | 19:50:10 | 15:40:10 | 15:50:10 | 10 |
| 02 July 2001 | 19:34:53 | 19:49:53 | 15:34:53 | 15:49:53 | 15 |
| 03 July 2001 | 19:30:23 | 19:35:23 | 15:30:23 | 15:35:23 | 5 |
| 04 July 2001 | 19:20:16 | 19:35:16 | 15:20:16 | 15:35:16 | 15 |
| 05 July 2001 | 19:24:35 | 19:44:35 | 15:24:35 | 15:44:35 | 20 |
| 16 July 2001 | 20:23:59 | 20:33:59 | 16:23:59 | 16:33:59 | 10 |
| 17 July 2001 | 20:18:59 | 20:43:59 | 16:18:59 | 16:43:59 | 25 |
| 18 July 2001 | 20:13:57 | 20:38:59 | 16:13:57 | 16:38:59 | 25 |
| 19 July 2001 | 20:14:36 | 20:34:36 | 16:14:36 | 16:34:36 | 20 |

- Remaining launch opportunities
 - July 29-August 3
 - August 14-18
 - August 28-September 2
 - September 13-17

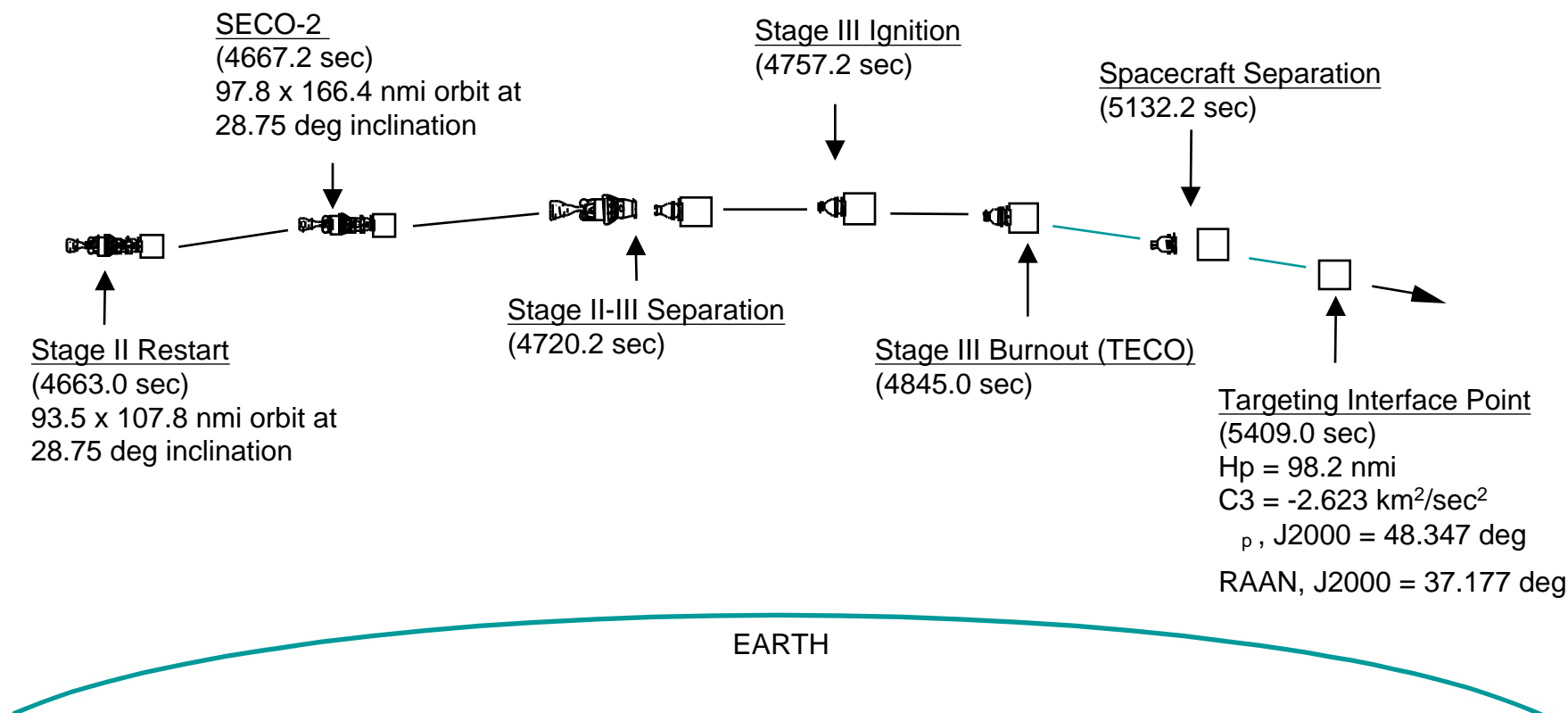




MAP Spacecraft Mission SECO-1-to-Spacecraft Separation Flight Profile

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EXPENDABLE LAUNCH VEHICLES



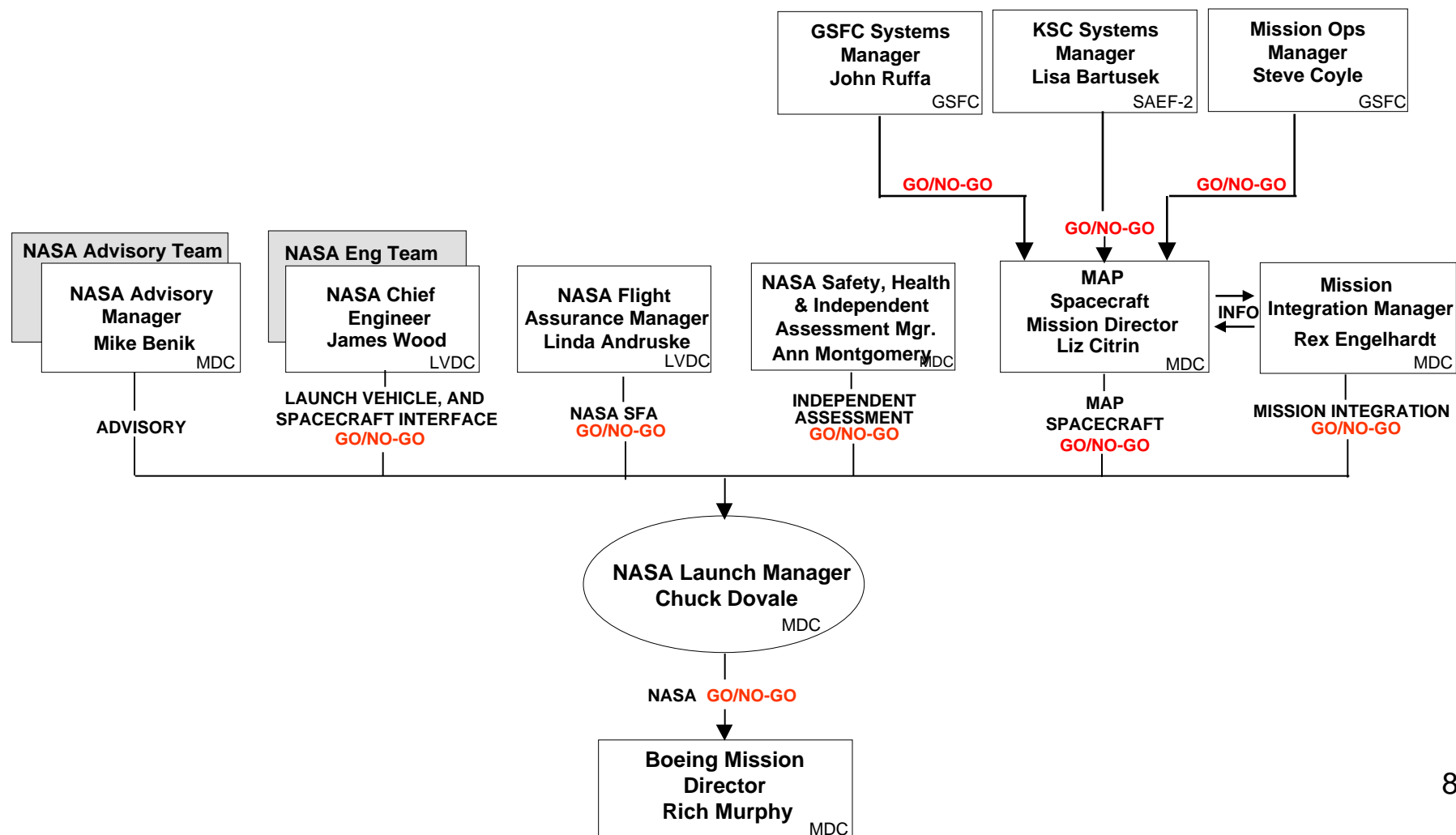
Note: Values shown are for the 30-June-01 launch date.



John F. Kennedy Space Center

Launch Day Management

EXPENDABLE LAUNCH VEHICLES





Readiness Reviews

John F. Kennedy Space Center

EXPENDABLE LAUNCH VEHICLES

| | | |
|---|---------------|-------|
| • Pre-Ship Review | 10 April | GSFC |
| • Spacecraft Mission Unique Red Team Review | 17 – 18 April | KSC |
| • Pre Vehicle On Stand | 3 May | HB |
| • KSC Center Director's Launch Vehicle Launch Readiness Review and Red Team Out-brief | 17 May | KSC |
| • Spacecraft MRR | 22 May | GSFC |
| • IMAR | 5 June | KSC |
| • Launch Site Readiness Review | 18 June | CCAFS |
| • Flight Readiness Review | 26 June | KSC |
| • Launch Mgt. Coordination Meeting / Mission Dress Rehearsal | 27 June | CCAFS |
| • Launch Readiness Review | 29 June | KSC |

Completed



Open Action Items From Previous Reviews

John F. Kennedy Space Center

EXPENDABLE LAUNCH VEHICLES

- **All open launch vehicle action items from the Red Team review and Pre-Vehicle on Stand (Pre-VoS) are in work**
- **Mission Unique Red Team**
 - Ratings Received: 3 Blue, 6 Green, and 1 Yellow
 - 8 RFAs received (7 KSC, 1 GSFC)
 - » 6 Closed
 - » 2 still being prepared for submission
 - Red Team understands answer – agrees - no issue anticipated
- **Pre-VoS review**
 - 5 Action items assigned
 - In work
- **KSC CDLVRR**
 - 2 Actions
 - In work



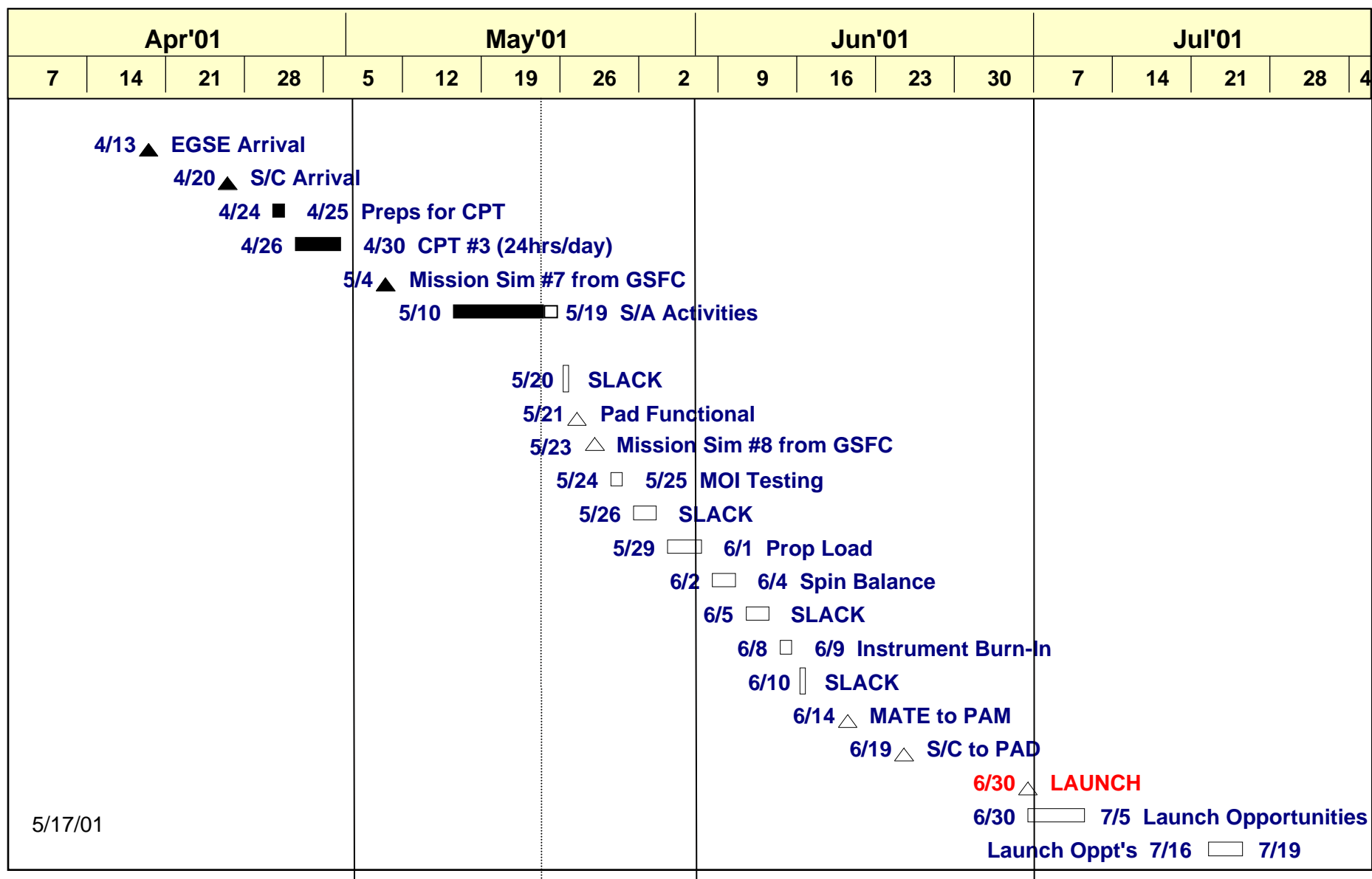
Schedule, Range & Launch Site Status



MAP S/C Launch Processing Schedule

John F. Kennedy Space Center

EXPENDABLE LAUNCH VEHICLES





Eastern Range Operations Schedule

John F. Kennedy Space Center

EXPENDABLE LAUNCH VEHICLES

June 2001

| SUN | MON | TUE | WED | THU | FRI | SAT |
|-----|---|---|-----|---|-----|---|
| | | | | | 1 | 2 <i>Pegasus MDR</i> |
| 3 | 4 | 5 | 6 | 7 <i>Pegasus HESSI 0600-1100 EDT</i> | 8 | 9 <i>Offshore Fishing Tournament</i> |
| 10 | 11 | 12 | 13 | 14 <i>STS-104 Launch</i> | 15 | 16 <i>Offshore Fishing Tournament</i> |
| 17 | 18 <i>Begin Atlas ICO-A1 countdown</i> | 19 <i>Atlas ICO-A1 0100-0200 EDT</i> | 20 | 21 | 22 | 23 <i>Offshore fishing Tournament</i> |
| 24 | 25 <i>STS-104 Landing</i> | 26 <i>Range Silence for Map Encapsulation @ SLC 17</i> | 27 | 28 | 29 | 30 <i>Delta MAP 1557 EDT Offshore Fishing Tournament</i> |

05/2/01
NASA/KSC

X Range Configuration
// Additional Launch Attempt(s)

 Holiday
 MAP Launch Periods



Eastern Range Operations Schedule

John F. Kennedy Space Center

EXPENDABLE LAUNCH VEHICLES

July 2001

| SUN | MON | TUE | WED | THU | FRI | SAT |
|-----|-----|-----|-----|-----|-----|-----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | 31 | | | | |

05/2/01
NASA/KSC

X Range Configuration
// Additional Launch Attempt(s)

Holiday
 MAP Launch Periods

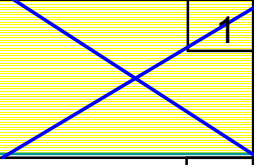
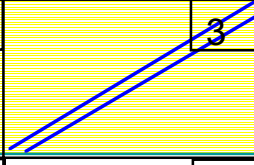
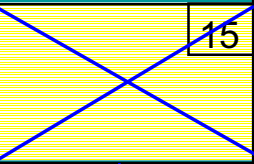
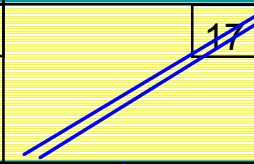


Eastern Range Operations Schedule

John F. Kennedy Space Center

EXPENDABLE LAUNCH VEHICLES

August 1 - September 2, 2001

| SUN | MON | TUE | WED | THU | FRI | SAT |
|-----|-----|-----|---|---------------------------|--|-----------------|
| | | |  1 | Titan B-31 Launch 2 |  3 | 4 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 12 | 13 | 14 |  15 | Delta GPS IIR-8 Launch 16 |  17 | 18 |
| | | | | | | Range Down Time |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | 31 | 1 |
| 2 | | | | | | |

05/2/01
NASA/KSC

X Range Configuration
// Additional Launch Attempt(s)
+ Range Down Time

 Holiday
 MAP Launch Periods



MAP Documentation Status

- **Spacecraft and Range Documentation**
 - All requirements and procedural documentation are in place to support spacecraft processing
- **Safety Documentation Status**
 - All safety documentation has been submitted and approved



RF Protection for MAP Update

- **Provide access control/security at Spacecraft Assembly & Encapsulation Facility (SAEF) II and SLC 17 to prohibit use of RF transmitters**
- **During transport of spacecraft to pad have NO police escort radars on and limit two-way radio to 2 watt transmitters**
 - Provide a 25 ft stayout zone from spacecraft canister during transport to SLC-17
- **Perform face-to-face meetings with the Range, other government agencies, Port Authority etc. to ask for their assistance in controlling RF emissions.**
 - Range meeting completed 5/3/01
 - Contacts made with Naval Ordnance Test Unit (NOTU), AF Weather & FAA
- **Establish a point of contacts list for operational control during MAP's maximum susceptibility period (fairing installation day) for ~14 hours**
- **Generate a Notice to Airman (NOTAM) requesting pilots avoid using radars that operate above 12 GHz within a given radius from KSC**
 - Project agreed with Red Team observation that widespread notification of MAP's sensitivity and vulnerable periods may be a risk, therefore NO NOTAM or Notice to Mariners (NOTMAR) will be issued.
- **Scheduled OD1040 Range silence for all Range emitters for MAP erection on 6/19 for 8 hours and for MAP encapsulation on 6/26 for 14 hours.**
 - Limited Range silence for MAP spacecraft protection granted during GeoLITE launch.
 - » Radar transmitted attenuation and azimuth protection provided.



Launch Vehicle Mission Unique Items



MAP Mission Integration Special Topics RF

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EXPENDABLE LAUNCH VEHICLES

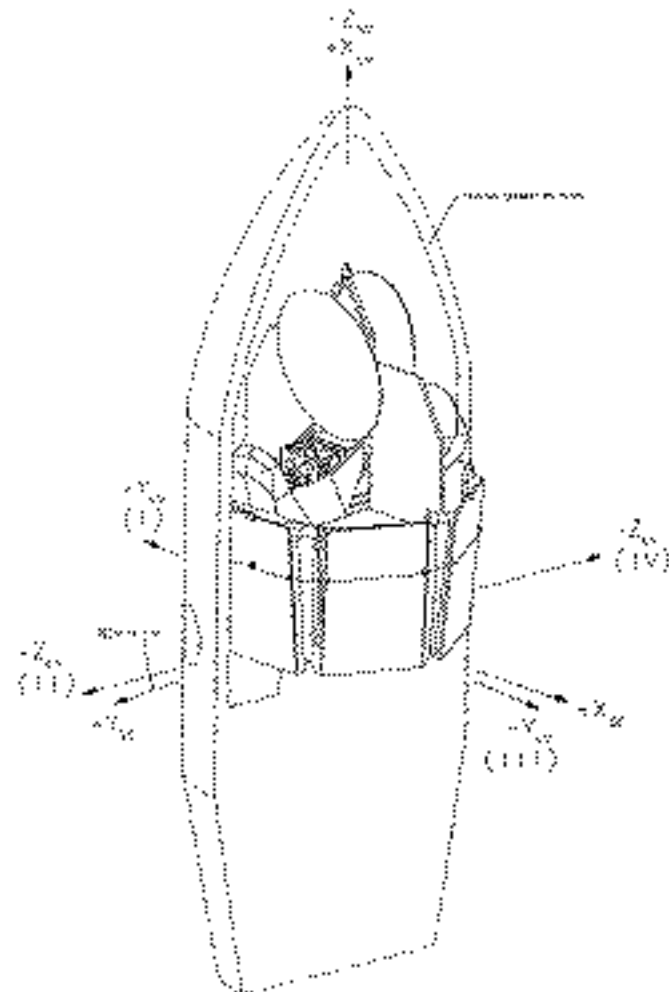
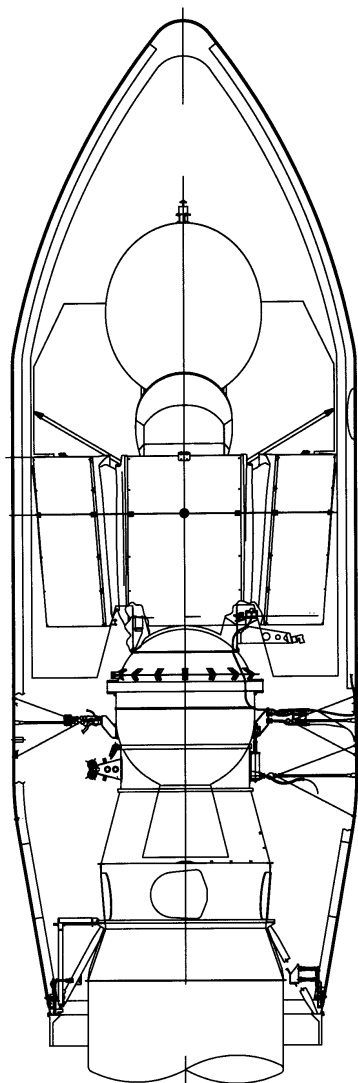
- **MAP microwave instrument is sensitive to RF radiation**
- **Goal is to Protect s/c from RF sources while at KSC and CCAFS**
- **Risk M0011 documents steps taken to mitigate s/c RF susceptibility**
 - **RF field strength test at CX 17. Continuous RF monitoring (Pad B 12/2/99 to 10/25/00, Pad A 11/16/00 to present) planned through launch, KSC and Map receive daily data updates.**
 - **Planned use of S and C band antenna hats during LV testing when s/c is mated to LV**
 - **Changed A/C shroud material to a similar material that provides additional RF attenuation (From NMD-FR 190NPA1-NN to NMD-FR 189NPA1-NN) Both approved materials.**
 - **Provided MAP with KSC recommended RF test levels (ERB - 00308KSC0). MAP tested to known RF levels that are out-of-band of the receiver.**
 - **Special Studies**
 - » **Redundant Telemetry RIFCA data instead of C-Band for Range Safety tracking was studied. Not feasible to implement in time for MAP (Range software was the long lead item).**
 - » **C Band attenuation (12 db) study performed. KSC recommended not proceeding with the C-Band attenuation. Added risk to Range safety system not warranted.**
 - » **Investigate Payload Fairing RF seals for access doors and a/c door. Directed Boeing to implement RF vent panel in PLF A/C Duct. All other proposed PLF modifications were not acceptable to KSC or MAP**
 - **Add a Honeycomb vent panel to the PLF A/C duct to reduce RF leak paths through A/C duct.**
 - **MAP will Install RF absorbing material (beam blocker) in critical areas of CX-17 white room**



MAP Observatory in Launch Configuration

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EXPENDABLE LAUNCH VEHICLES



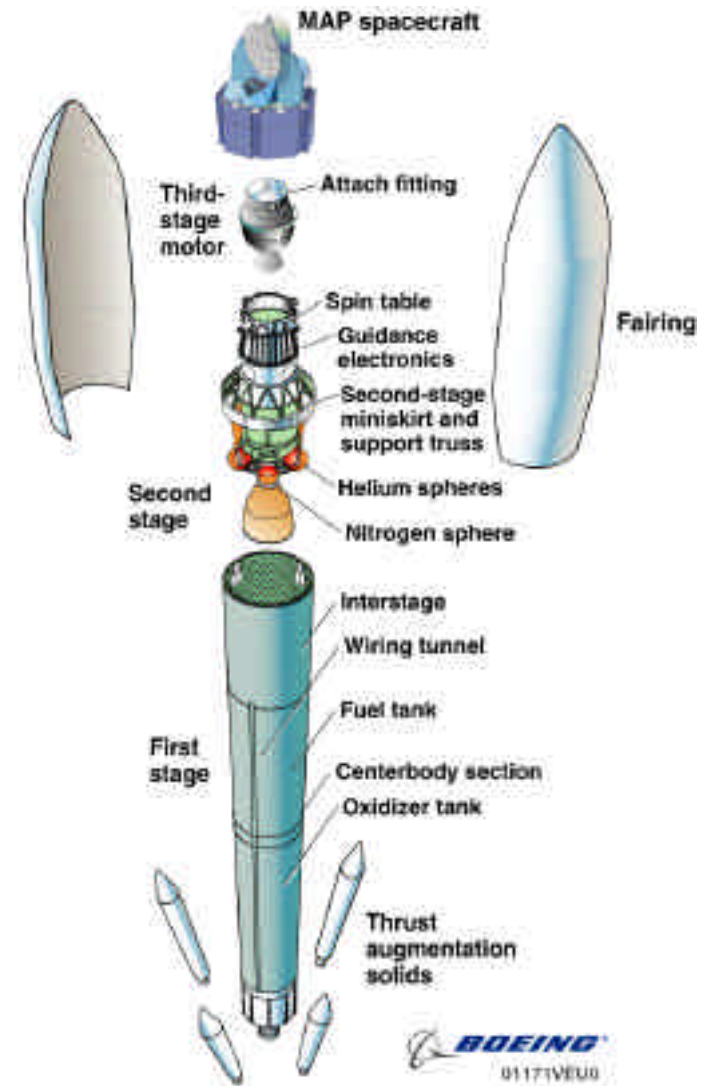


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MAP Mission Unique Items

EXPENDABLE LAUNCH VEHICLES

- 7425-10 booster configured for Eastern Test Range (ETR) (ERB 01322KSC0 7425-10C DCR)
- First Stage
 - 4 Ground ignited GEM positions 1, 2, 6, and 9
- Interstage
 - Configured for 10 ft fairing with 60 in² AC vent door removed
- Second Stage Modifications
 - Configured spacecraft wire harness for mission requirements
 - Configured for 10 ft fairing and STAR 48B Third Stage motor
 - Configured for Med-Lite instrumentation (payload fairing acoustic microphone, pressure transducer and temperature sensor in Q1 fairing half)
 - Propellant tank shall incorporate standard extended mission side wall blankets due to long mission duration
 - Propellant shall contain less than or equal to 0.30 ppm iron due to PLF A/C (52.5 ± 2.50 F)





MAP Mission Unique Items (continued)

- **Spintable**
 - Configured for STAR 48B Third Stage motor (ERB 00339KSC0 Anti Rotation System Configuration Change)
 - 6 Spin rocket configuration (four 1.0-KS190 motors and two 1.0-KS210 motors)
 - Incorporate extended mission thermal control modifications
- **Third Stage**
 - STAR 48B Motor
 - 3712C Payload Attach Fitting
 - (2) 37 pin S/C electrical interface connectors
 - » S/C monitored separation detected by 3 continuity break-wire indications
 - Ballast capability to accommodate for variation of S/C weight and 2nd stage restart burn to meet S/C trajectory requirements
 - Nutation Control System with 37 lb. thruster
 - Yo-Yo Despin system with weights tailored to S/C mass
 - » Despin to 0 ± 2 RPM
 - Star 48B Event Sequencing System (ESS) for despin/NCS mission
 - Configured for an extended mission thermal control

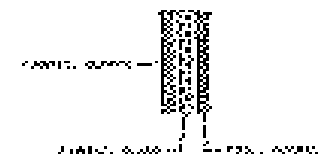


MAP Mission Unique Items (continued)

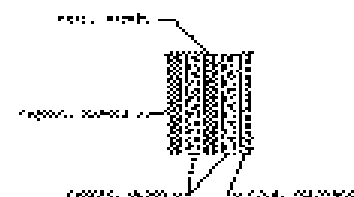
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EXPENDABLE LAUNCH VEHICLES

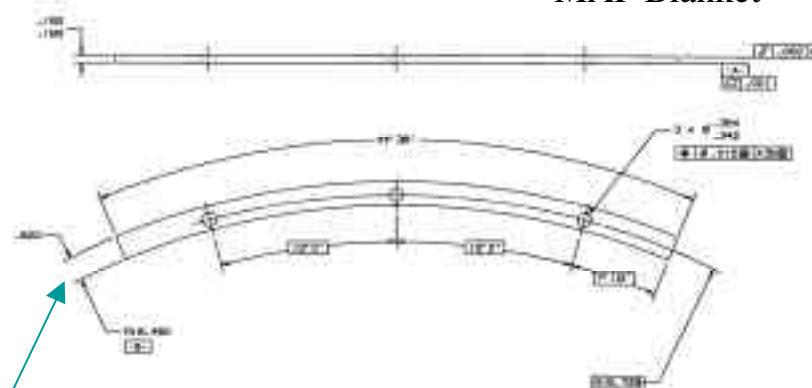
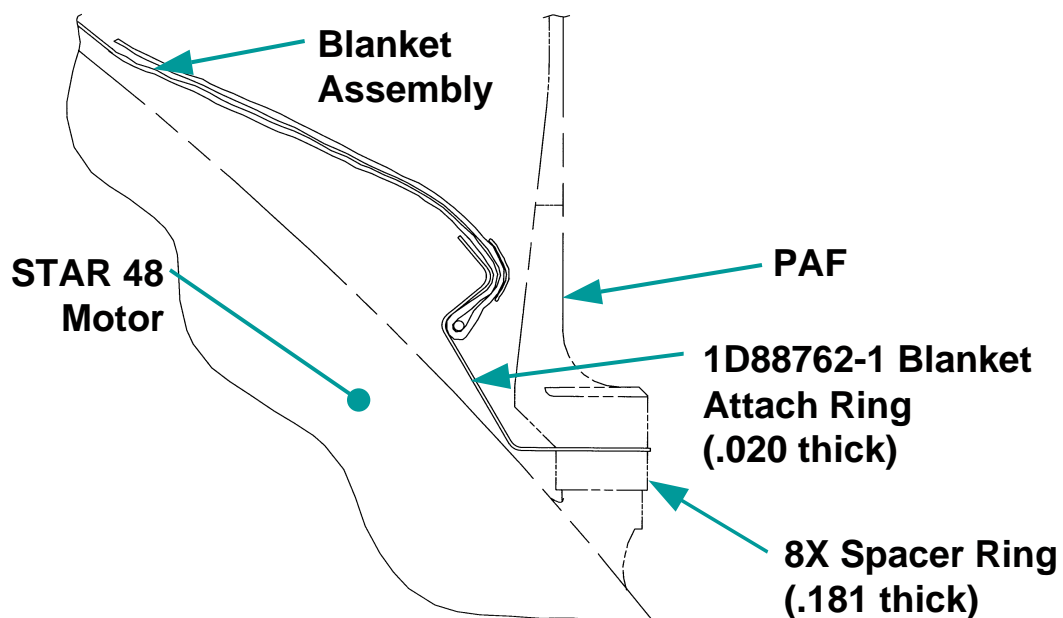
- **Third Stage (continued)**
 - **5 layer motor dome blanket required to protect s/c (ERB 00331KSC0)**
 - » A layer of Polyimide Film and Glass Fabric are added to the existing 3 layers of Nickel Foil, Glass Fabric, and Quartz Fabric.
 - **Use 8 segment stainless steel spacers instead of 24 titanium spacers**
 - **PAF, Star 48 Motor Dome and Motor Dome Blanket Cleaned to VC-5**



Standard Blanket



MAP Blanket





MAP Mission Unique Items (continued)

- **Third Stage (continued)**

- **T-0 GN₂ purge at PAF umbilical bracket for s/c battery cooling (ERB 01328 KSC0 5/22/01)**

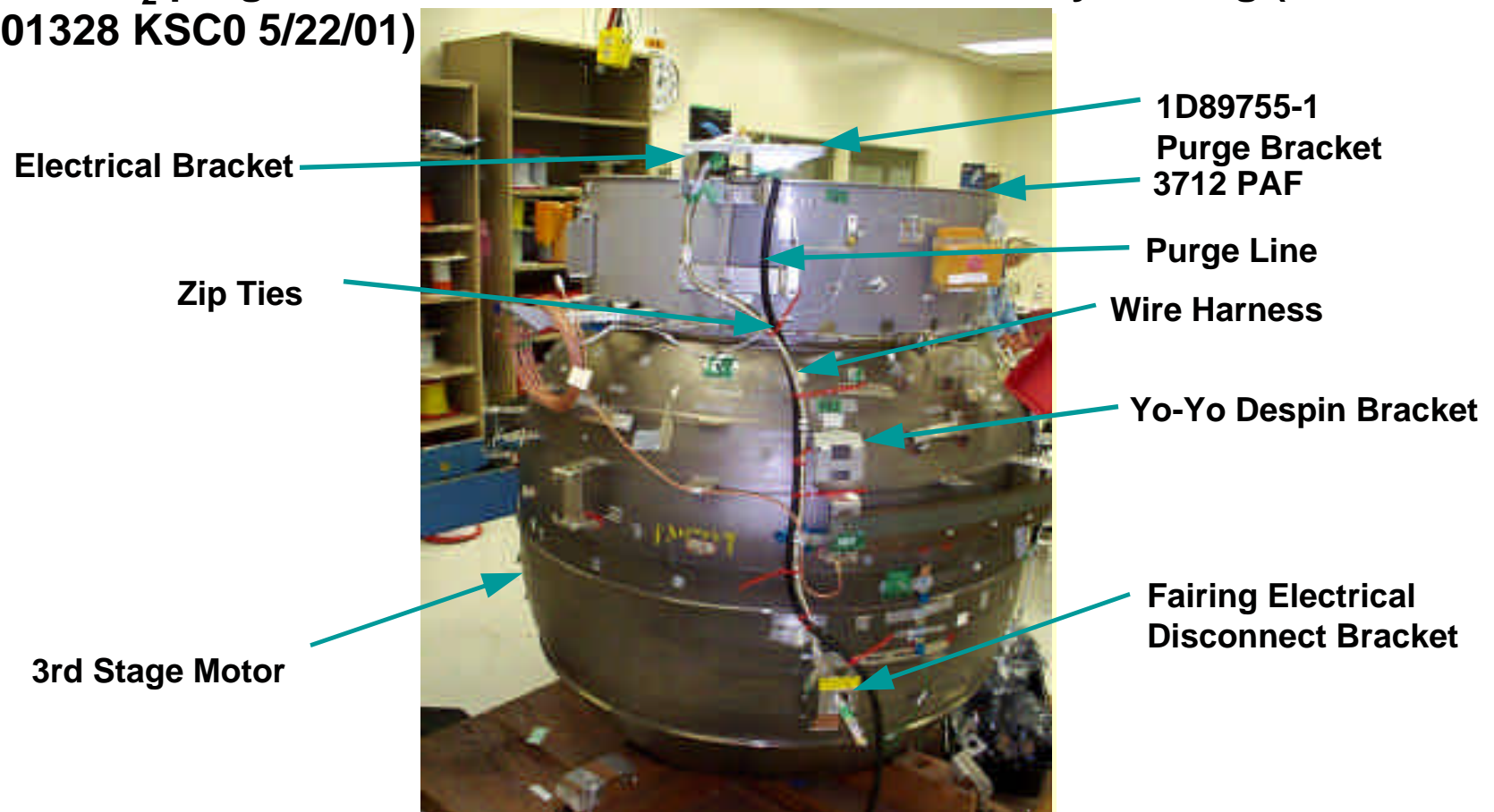


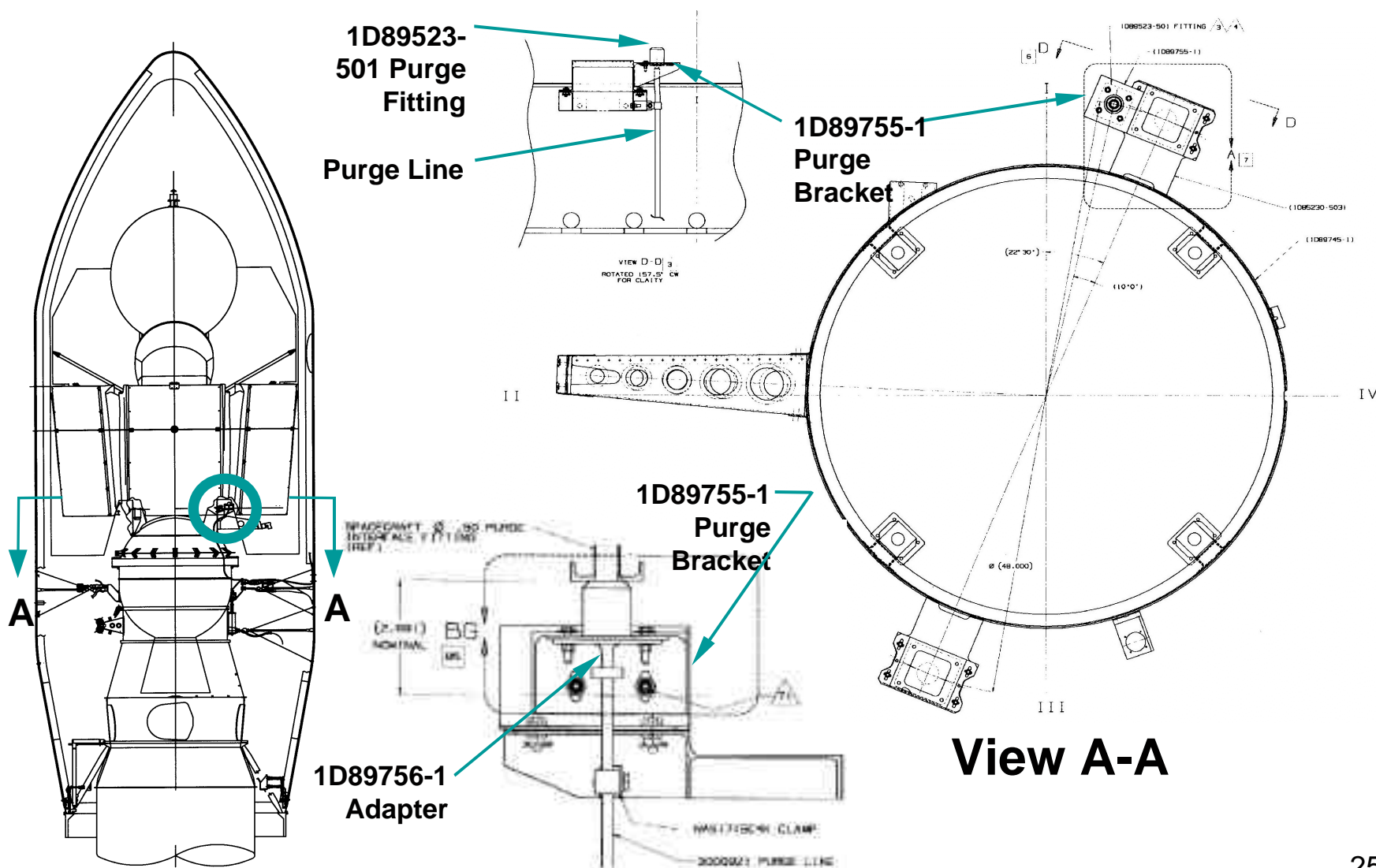
Photo of GN2 system mock-up



MAP Mission Unique Items (continued)

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EXPENDABLE LAUNCH VEHICLES



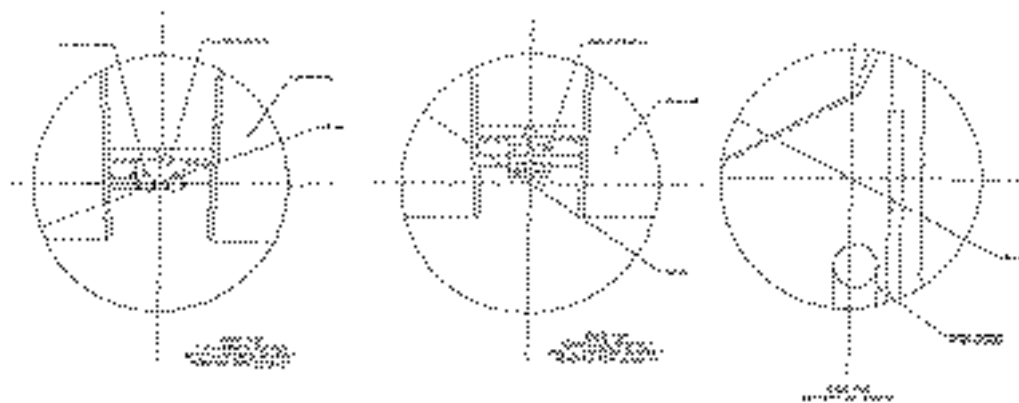


MAP Mission Unique Items (continued)

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EXPENDABLE LAUNCH VEHICLES

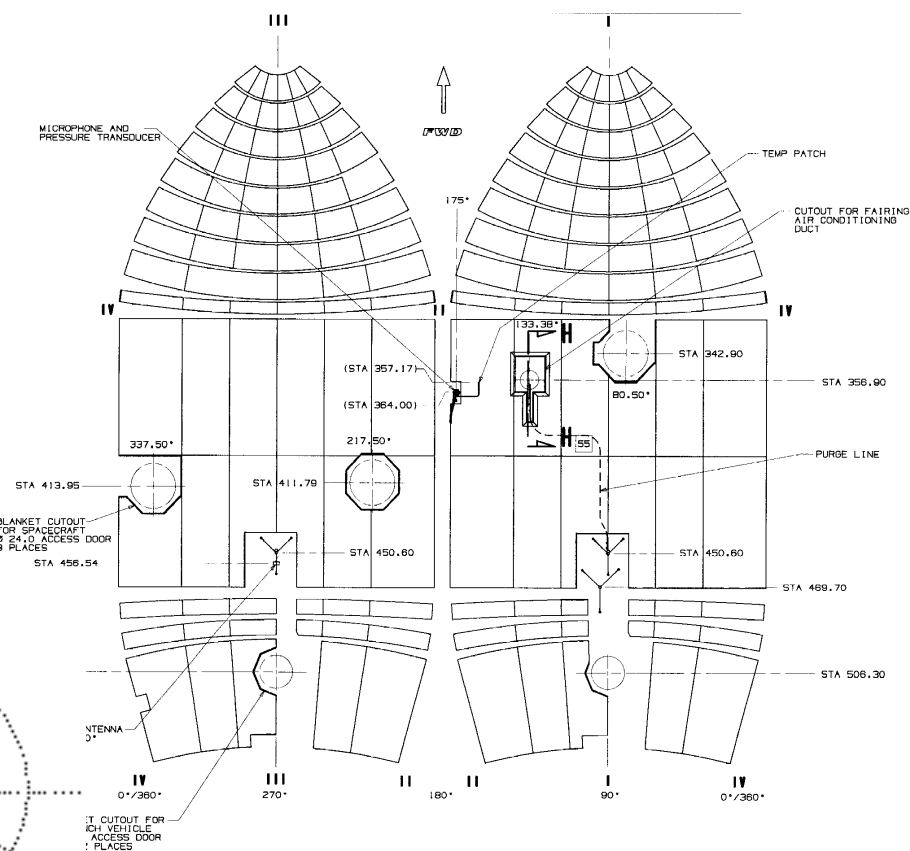
- **Payload Fairing**
 - Three 24.0 in. diameter access doors
 - » S/C Battery cooling duct
 - » S/C Fill and Drain valves
 - » S/C connectors
 - Standard 3.0" thick acoustic blankets with 5 micron filters
 - Fairing will be cleaned to VC-6



Access Door #
1 Fill and
Drain Valves

Access Door # 2
S/C Connectors

Access Door # 3
Battery Air Feed Tube





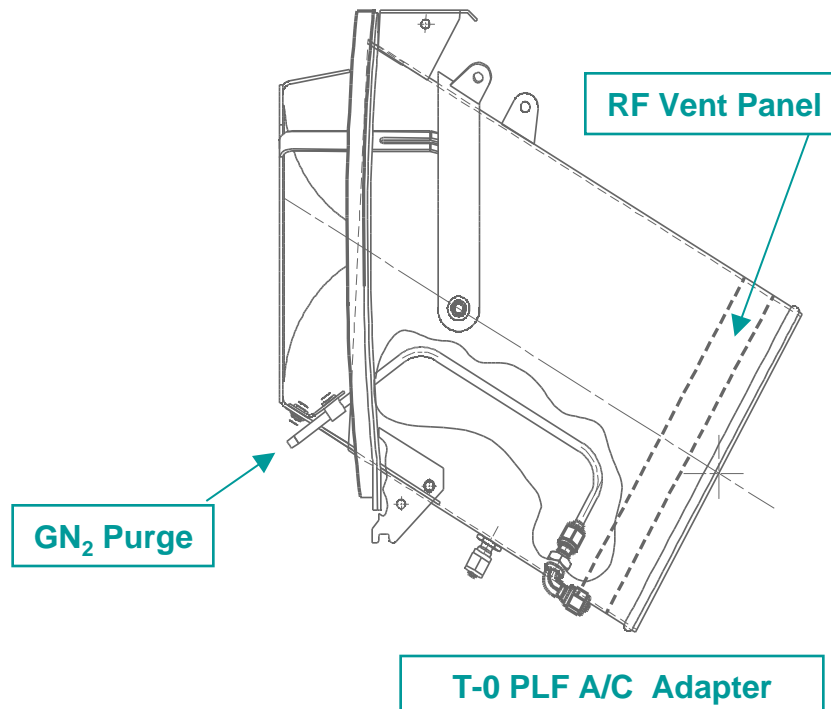
MAP Mission Unique Items (continued)

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EXPENDABLE LAUNCH VEHICLES

- **GSE and Facilities**

- Provide for GN₂ purge during transport
- Changed A/C shroud material to a similar material that provides additional RF attenuation
- Provide GPS Battery Cooling Cart for S/C battery cooling
- Provide A/C Adapter with standard diffuser including cold GN₂ Purge
- Provide RF shield (vent panel) on Fairing A/C Adapter (ERB 01329KSC0 5/31/01)
- Provide hat couplers for Second Stage S-band antennas for S/C RF protection
- Accommodate S/C provided RF blanket panels on whiteroom walls





Launch Vehicle Status



Core Vehicle Reviews

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EXPENDABLE LAUNCH VEHICLES

- **The following hardware readiness reviews have been completed successfully**
 - **First stage**
 - **Second stage**
 - **Third stage (STAR 48)**
 - **Redundant Inertial Flight Control Assemble (RIFCA)**
 - **Second stage engine**
 - **Main and Vernier Engines**
 - **Fairing**
 - **Spin table**
 - **Graphic Epoxy Motors (GEMs)**
 - **Payload Attach Fitting (PAF)**
- **Vehicle Readiness Review (VRR) is scheduled for May 23**
- **All hardware reviews have been completed and there is one open action item**
 - **Third Stage Hydrazine Pressure Transducer Failure Analysis**
 - » **Covered under Special Attention Items**



First Flight Items

- **7425-10C Launch Vehicle Configuration**
 - First use of third stage with a 10 ft composite (-10C) payload fairing
- **Upper Stage Anti Rotation Cord Titanium Spring**



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First Flight Item 7425-10C Vehicle Configuration

EXPENDABLE LAUNCH VEHICLES

- **First use of third stage with 10 ft composite fairing**
 - 7420-10C (no third stage) flown for Globalstar missions
 - 7426 (STAR 37 third stage, 9.5 ft fairing) flown for Stardust
- **Design Certification Review (DCR) Engineering Review Board (ERB) 01322KSC0 convened April 12, 2001**
 - **Controls and dynamics**
 - » Vehicle very similar to 7420-10C Globalstar series of missions
 - » Acceptable margins within flight experience
 - » RIFCA Enhanced Flight Program (EFP) (first flown on Landsat VII) allows great increase to launch probabilities over earlier 7420-10Cs
 - » Payload fairing separation clearances unaffected by third stage
 - » Some controls analyses incomplete, but in work and expected complete in sufficient time for NASA review prior to launch



First Flight Item Third Stage Anti-Rotation Cord System Spring

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EXPENDABLE LAUNCH VEHICLES

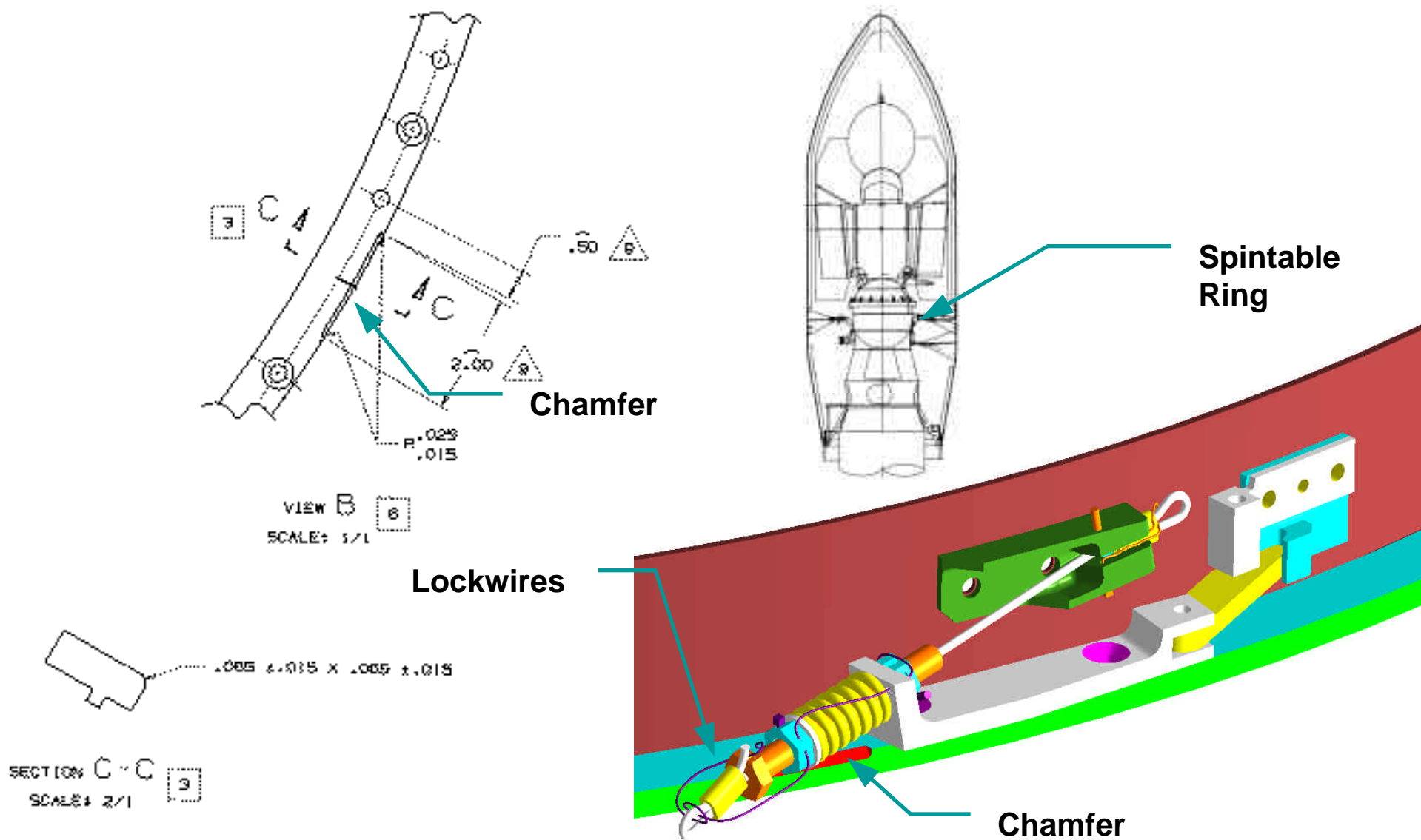
- **Replaced steel spring with titanium spring**
 - Better resistance to stress corrosion
- **Titanium spring qualified by test**
 - Demonstrated that new spring maintained same characteristics as the original steel spring
- **New spring is slightly larger in diameter**
 - New spring seats maintain concentricity with the inner bolt
 - Spintable outer retainer ring was reworked to add a .065" X .065" chamfer over a 2 inch length to prevent interference
- **ERB 00339KSC0 convened 6 March 01 and concluded that anti-rotation cord system is acceptable as a first flight item**



New Spring for Anti-Rotation Cord (Continued)

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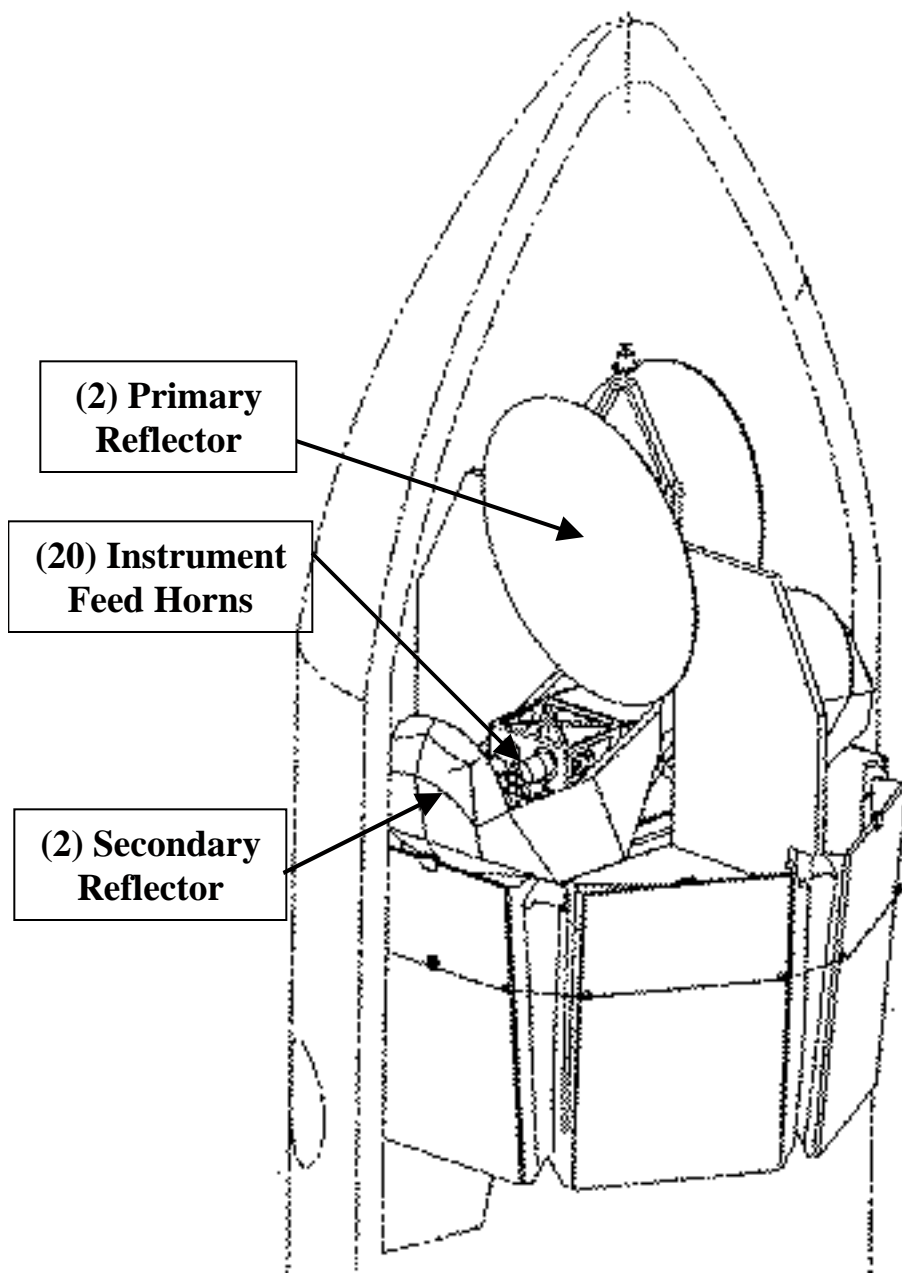
EXPENDABLE LAUNCH VEHICLES





Prior Flight Anomaly Odyssey Fairing Separation Debris

- **Particulates or debris seen at fairing separation and third stage spinup**
 - **Particles clearly visible from on-board camera at payload fairing separation and third stage spinup**
 - » **Origin is currently unknown, but confined to surfaces forward of, or in immediate proximity to, the second stage forward-looking camera on the guidance section**
- **Investigation is in work**
 - **Boeing has prepared a fishbone**
 - » **NASA is currently assisting development and closure**
- **This issue requires NASA ERB disposition for MAP**
 - **Currently constraint to fairing erection in tower (~29 May)**
 - » **NASA working with Boeing to develop plan to gain relief from that deadline**
 - **Odyssey used a 9.5 ft metal fairing, MAP will fly a 10 ft composite**
 - » **Investigation has not yet concluded that root cause is absent from a 10C fairing**
- **MAP most sensitive to conductive FOD in the antenna feedhorns**
- **This anomaly investigation is open and being worked by the NASA and Boeing engineering teams**



- **MAP Observatory Most Sensitive to Particulate contamination**
 - Primary and Secondary Reflectors
 - Feed Horns (especially sensitive to metallic contamination)
 - Star Trackers and Sun-sensor Optics
- **MAP Observatory Less Sensitive to Molecular Contamination**
 - Star Trackers and Fine Sun-sensor optics
 - Solar Arrays

| Component | At Launch | | End of Life | |
|---------------------------------|----------------------------------|----------------------------------|---------------|-------------------------|
| | Particulates | Molecular | Particulates | Molecular |
| Primary Instrument Reflectors | Level 500 | 200 Angstroms (Level B) | Level 700 | 50,000 Angstroms |
| Secondary Instrument Reflectors | Level 500 | 200 Angstroms (Level B) | Level 700 | 50,000 Angstroms |
| Feed Horns and Detectors | Level 500 | 200 Angstroms (Level B) | Level 700 | TBD |
| Instrument Radiators | Level 500 | 200 Angstroms (Level B) | Level 700 | TBD |
| Star Trackers | Level 500 | 200 Angstroms (Level B) | Level 700 | 400 Angstroms (Level D) |
| Digital Sun Sensors | Level 500 | 100 Angstroms (Level A) | Level 700 | 1500 Angstroms |
| Course Sun Sensors | Visibly Clean – Highly Sensitive | Visibly Clean – Highly Sensitive | Visibly Clean | Visibly Clean |
| Solar Array Cells | Visibly Clean – Highly Sensitive | Visibly Clean – Highly Sensitive | Visibly Clean | Visibly Clean |
| Solar Array OSRs | Level 600 | 100 Angstroms (Level A) | Level 700 | 700 Angstroms (Level G) |
| Spacecraft Bus Radiators | Level 500 | 200 Angstroms (Level B) | Level 700 | 900 Angstroms |
| General Spacecraft Surfaces | Visibly Clean – Highly Sensitive | Visibly Clean – Highly Sensitive | None | None |

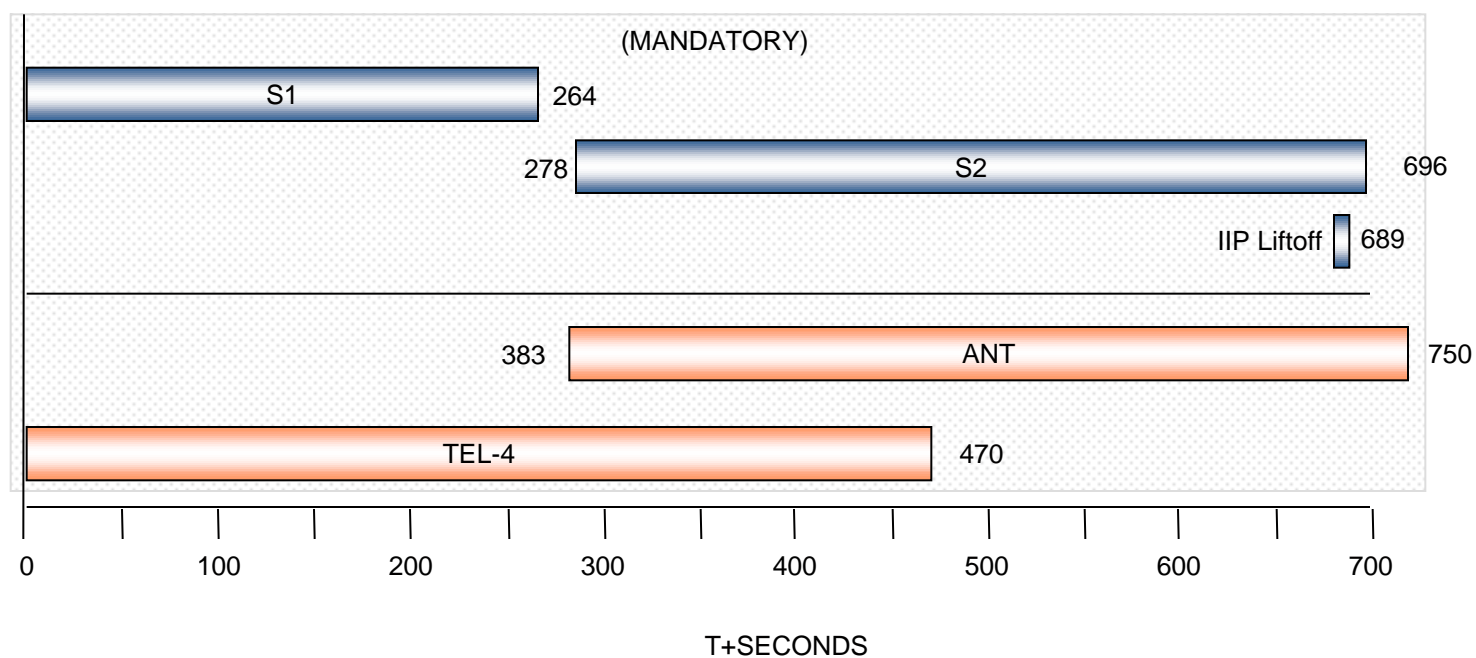


Communication, TM and Tracking



NASA / KSC Status

- **Launch Vehicle data coverage: Liftoff through SECO-1**
 - **30 June through 17 Sept**

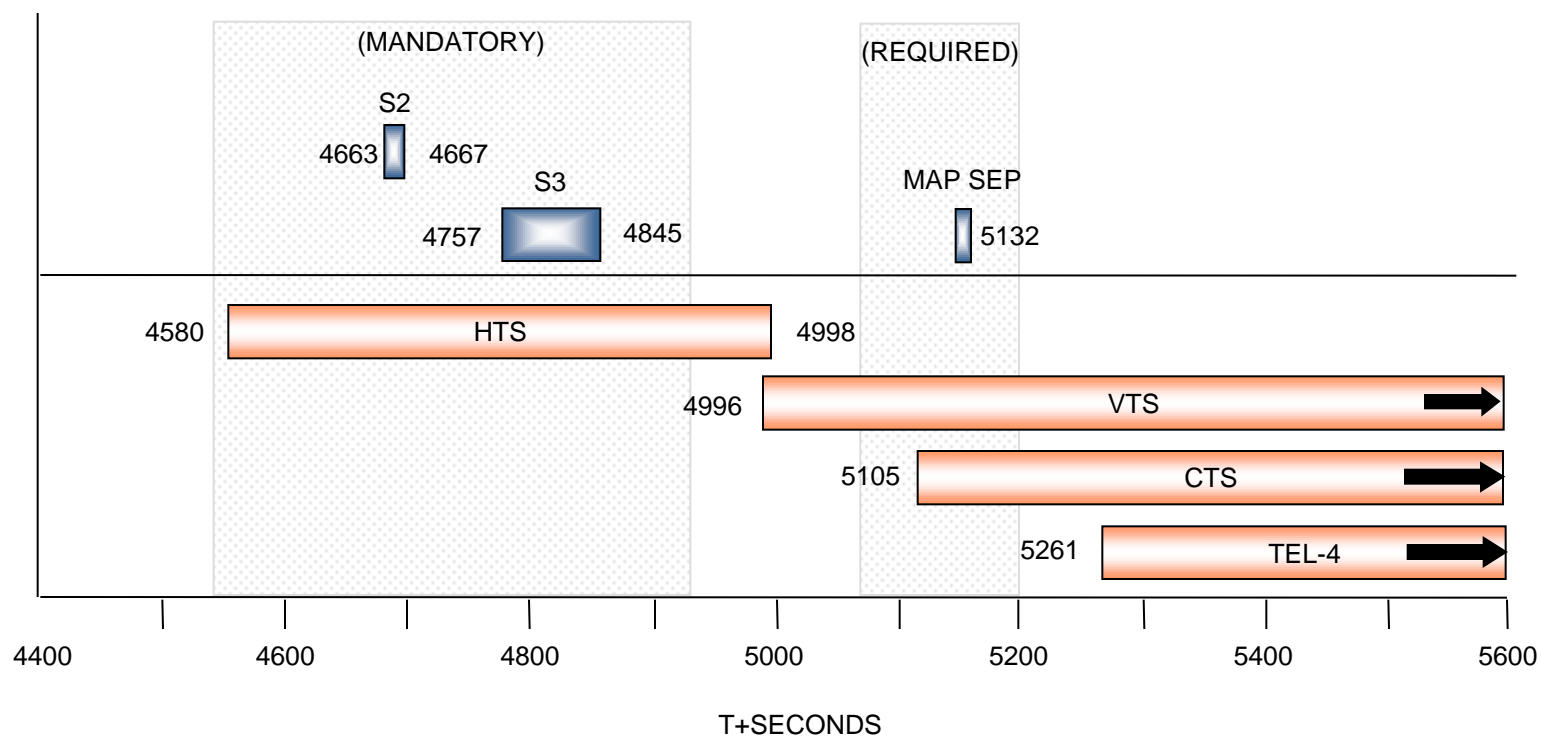


*AOS/LOS times are taken from DTO Addendum dated 5 March 2001



NASA / KSC Status

- **Launch Vehicle data coverage: Restart through S/C Separation**
 - **30 June**



*AOS/LOS times are taken from 0 Deg Elevation, DTO Addendum dated 5 March 2001

Depletion Burn Coverage provided by TEL-4 and ANT



Readiness Statement



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Readiness Statement

EXPENDABLE LAUNCH VEHICLES

KSC is ready to proceed with processing and launching the MAP mission.



Backup



CDLVRR Actions

- **Action 1: KSC ELV and MAP project to further investigate additional ways to reduce risk of RF exposure of the MAP spacecraft during critical times.**
- **Action 2: KSC public affairs to investigate whether car passes will be issued for the MAP launch.**



Red Team Actions

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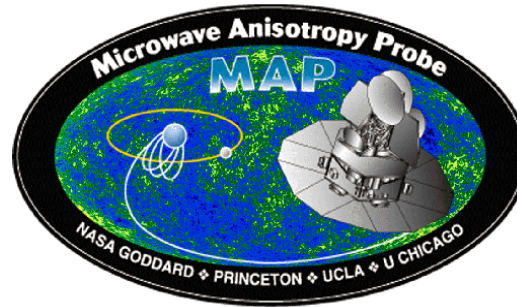
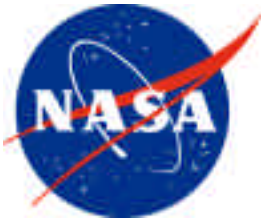
EXPENDABLE LAUNCH VEHICLES

MAP RFA Tracking sheet

Rev: Date 5/14/01

| RFA# | Subject | Primary Responsible Org | Assigned to POC | Type | Due Date | Expected Closure Method |
|-------|--|-------------------------|-----------------|--------------|------------|---|
| MAP-1 | Post-Flight Analysis Issues | NASA/KSC | James Wood | Engineering | 37021 | RFA response explaining process |
| MAP-2 | S/C to PLF Clearance | NASA/KSC | Albert Sierra | Engineering | 05/10/2001 | Will Measure clearance during fairing installation. RFA closure to explain. |
| MAP-3 | Payload RF Sensitivity | NASA/KSC | Tom Rucci | Launch Site | 37021 | |
| MAP-4 | Copy of MAP Related ERBs | NASA/KSC | Albert Sierra | Engineering | 05/10/2001 | ERB R&R's to be supplied. |
| MAP-5 | MAP RF Sensitivity Levels Definition | NASA/KSC | Rex Engelhardt | Spacecraft | 05/10/2001 | Levels and actions defined. |
| MAP-6 | Adequacy of Staffing for the MAP Mission | NASA/KSC | Rex Engelhardt | Project Mgmt | 05/10/2001 | Staffing explained/identified |
| MAP-7 | Fuel Seepage | NASA/KSC | James Wood | Engineering | 37022 | RFA Response will explain issue flight rationale |
| MAP-8 | Failure analysis of the capacitor for the first stage Power & Control Box, S/N 20016 | NASA/KSC | James Wood | Engineering | 37022 | RFA Response will explain issue flight rationale |

| | |
|---------------------------------|---|
| I/W by KSC or Assigns in white | Note: S/C specific RFA are highlighted in light blue |
| Submitted to Red Team in Yellow | |
| Closed in Gray | |



Microwave Anisotropy Probe (MAP)

Launch Vehicle Services

Red Team

GSFC

Mission Readiness Review

5/22/01

*Joe Nieberding, Chair
MAP Launch Vehicle Red Team*

Outline

Background

Team Members

Checklist and Scoring

Residual Risk Assessment

Summary

Conclusion

Appendix

Background

A Fleet Review for Delta was held on February 13-14, 2001.

The MAP Mission Unique Launch Vehicle Services Red Team Review was held on April 17, 2001.

- **MAP findings are based on the information presented at that time, Fleet Review findings, Pre-VOS data, and Request for Action (RFA) closure results**
 - Technical concerns surfaced and are addressed in this report
- **The Red Team does not follow vehicle preparation after the review, except for Pre-VOS update**

Team Members

RED TEAM MEMBER

CURRENT AFFILIATION PRIOR AFFILIATION

| | | |
|------------------------------|-------------------|---------------|
| Lyle J. Holloway | Analex Consultant | Boeing, Delta |
| Don Miller (1) | Swats | GSFC |
| John J. (Joe) Nieberding (3) | Analex Consultant | NASA GRC |
| John Pandelides (2) | Swats | GSFC |
| William M. Piland | Analex Consultant | NASA LaRC |
| Donna L. Shirley | Analex Consultant | JPL |
| Omer F. (Frank) Spurlock (4) | Analex Consultant | NASA GRC |
| William E. Taylor | Analex Consultant | NASA MFSC |
| Jack Yeh | Aerospac | |

(1) MAP S/C Red Team Chair (2) Map S/C Red Team Member (3) LV Red Team Chair
(4) Co-Chair LV Red Team

Scoring

The effectiveness of the KSC/Boeing team in designing and implementing processes to minimize launch vehicle risks to mission success was scored.

Each Mission Unique checklist item, except Item A (only descriptive), was scored using the following rating system:

- **Blue: superior**
- **Green: nominal**
- **Yellow: deficient**
- **Red: substantially deficient**

A similar Fleet Review checklist was evaluated in the Delta Fleet Review and scores were 7 blue, 3 green.

The following charts describe each Mission Unique checklist item and the Red Team's findings and scores.

Mission Unique Scores

The mission unique scores for all ten checklist items were either blue (three) or green (six), with the exception of item K, discussed on the next chart.

MAP Mission Unique Scores











K) Assessment of the results of post-flight analyses for potential risk on this mission

Findings: (RFA's 1 and 7)

- ⟨ The apparent vibration anomaly on EO-1/SAC-C has yet to be explained to the Red Team, and post flight analysis must be completed to determine any possible:
 - Implications for MAP
 - Implications for effectiveness of post-flight assessment process
- The Mars Odyssey booster engine short burn and kerosene “seepage” may have implications for the MAP mission; resolution is required prior to MAP launch in accordance with KSC/Boeing policies

PRELIMINARY SCORE: YELLOW 

MAP Mission Unique Scoring Summary

| <u>Checklist Item</u> | <u>Scores</u> |
|---|--|
| A) Description..... | Not scored |
| B) Organizational structure..... | Green  |
| C) Schedule..... | Blue  |
| D) Mission Unique..... | Blue  |
| E) Requirements definition..... | Blue  |
| F) Launch vehicle history..... | Green  |
| G) Independence of reviews..... | Green  |
| H) Risks..... | Green  |
| I) Analysis and test processes..... | Green  |
| J) Interface single-point failures..... | Green  |
| K) Post-flight analyses..... | Yellow  |

Residual Risk Assessment

At the time of the review, the Red Team identified two “residual” risks that were anticipated to be mitigated prior to launch.

The following five by five matrix was used for residual risk assessment:

Residual Risk Matrix

| | | | | | | |
|----------------------------|---|---|---|---|---|---|
| Probability Probability | 5 | L | M | M | H | H |
| | 4 | L | L | M | H | H |
| | 3 | L | L | L | M | M |
| | 2 | L | L | L | L | M |
| | 1 | L | L | L | L | L |
| | | 1 | 2 | 3 | 4 | 5 |

Consequence

Probability of Occurrence

Source is the judgment of the Red Team

Very Low
Low
Moderate
High
Very High

Consequences

Source is the Red Team criticality assessment .

Minimal or no impact.
Moderate impact using same technical approach.
Moderate impact with workarounds possible; can meet mission requirements.
Major impacts in technical, cost, or schedule; inability to meet mission requirements.
Unacceptable technical, cost, or schedule impacts; loss of mission.

Residual Risk #1, as of Red Team Review: Radiation Exposure

Concern: Potential for excessive spacecraft exposure to microwave radiation during ground processing

- **Current lack of definition of critical RF exposure levels introduces uncertainty**

Risk: Potential mission degradation (or failure)

Mitigations:

- **The MAP Project should define their critical RF sensitivity levels and resultant retest and/or processing hold requirements**
- **The Map Project should conduct a formal review after spacecraft installation and prior to second stage propellant loading to verify that the RF exposure history is acceptable**

Residual Risk #1, as of Red Team Review: Radiation Exposure

Mitigations (continued)

- In discussions with the Port Authority, make sure military vessels are included (U.S. and foreign)
- Request the issuing authority of NOTAM to include military vessels
- Evaluate impact of security and safety issues before taking these actions

Consequence: 5

Probability of occurrence: 2

Risk: Medium

| | | | | | | |
|----------------------------|---|-------------|---|---|---|---|
| Probability Probability | 5 | L | M | M | H | H |
| | 4 | L | L | M | H | H |
| | 3 | L | L | L | M | M |
| | 2 | L | L | L | L | M |
| | 1 | L | L | L | L | L |
| | | 1 | 2 | 3 | 4 | 5 |
| | | Consequence | | | | |

Residual Risk #1, Current Assessment: Radiation Exposure

Mitigations have been implemented and RFA 3 has been satisfactorily closed.

Consequence: 5

Probability of occurrence: 1

Risk: Low

| | | | | | | |
|----------------------------|---|-------------|---|---|---|---|
| Probability Probability | 5 | L | M | M | H | H |
| | 4 | L | L | M | H | H |
| | 3 | L | L | L | M | M |
| | 2 | L | L | L | L | M |
| | 1 | L | L | L | L | L |
| | | 1 | 2 | 3 | 4 | 5 |
| | | Consequence | | | | |

Residual Risk #2, as of Red Team Review: Applicable Post-Flight Analysis

Concern: Potential applicability of EO-1/SAC-C mission vibration anomaly, and Odyssey under burn and kerosene “seepage” to the MAP launch vehicle

Risk: Potential mission degradation or failure

Mitigation: Complete the anticipated post-flight assessment process for potential applicability of these events to MAP

Consequence: 5

Probability of occurrence: TBD

Risk: TBD

| | | | | | | |
|----------------------------|---|-------------|---|---|---|---|
| Probability Probability | 5 | L | M | M | H | H |
| | 4 | L | L | M | H | H |
| | 3 | L | L | L | M | M |
| | 2 | L | L | L | L | M |
| | 1 | L | L | L | L | L |
| | | 1 | 2 | 3 | 4 | 5 |
| | | Consequence | | | | |

Summary

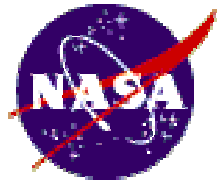
Based on the MAP Mission Unique Review information, Fleet Review information, and the expected responses to the remaining two open RFAs, the Red Team concludes:

- Risk associated with the spacecraft radiation environment during ground processing is low, but cannot be totally eliminated
- Post-flight concerns will be eliminated before MAP launch

Conclusion

***The Delta II launch vehicle is a
low risk to MAP mission
success.***

APPENDIX



Briefing

GSFC Program Management Council

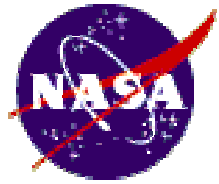
MAP Red Team Evaluations

Mission Readiness Review

May 22, 2001

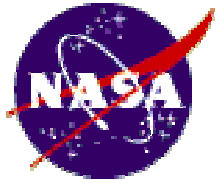
Donald L. Miller

Swales Aerospace



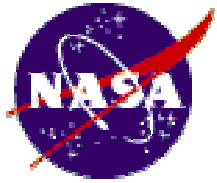
Contents

- Red Team Activities
- Red Team Members
- Mission Success Requirements
- Summary Evaluation of 13 Processes
- Residual Risks
- Launch Vehicle
- Summary of Findings
- Conclusions
- Appendix A - Charter, Scope, Evaluation Approach
- Appendix B –Scoring Details for 13 Processes
- Appendix C –Rating Details for Residual Risks



Red Team Activities

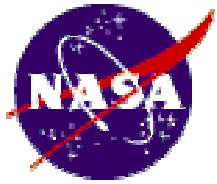
- **Phase One Review conducted September 12-13, 2000**
 - Reviewed 13 Processes and Project Plans
 - Reviewed the Phase One Debriefing Report with Project on October 12, 2000
 - Thermal engineer attended many Branch reviews of thermal design & test program
- **Phase Two Review conducted as part of the S/C PSR on April 10-11, 2001**
 - Reviewed Integration & Test results and Phase One Action Item responses
 - Red Team caucus at GSFC to finalize results on April 11, 2001
 - Project debriefing at GSFC on April 11, 2001
 - Reviewed the MRR Briefing Report with Project on May 15, 2001
- **ELV Mission Unique Review conducted by KSC Red Team on April 16-18, 2001**
 - Mission Red Team Cross-members attended (Pandelides, and Miller)
 - Telecon review of Delta Pre-VOS data on May 7, 2001
 - Provided evaluations to the KSC Red Team Chairman (J. Nieberding)



Red Team Members

- John Andrews- Univ. of Colorado, Center for Astrophysics & Space Astronomy
- Steve Battel – Battel Engineering
- Mike Coyle – NASA Retired, Swales Aerospace
- Paul Delahunt – Naval Research Laboratory
- Kathleen Howell – Purdue University
- John Mangus – NASA Retired, Bart & Associates
- Don Miller - NASA Retired, Swales Aerospace
- Joe Nieberding/ Frank Spurlock* – NASA Retired, Analex Corporation
- John Pandelides – NASA Retired, Swales Aerospace
- Larry Ruberl *– Swales Aerospace
- Andy Santo – JHU Applied Physics Laboratory
- Stan Sobieski – NASA Retired, Swales Aerospace

* Members required by GSFC/KSC early agreement



Mission Science Requirements

- **Baseline Science Mission ***

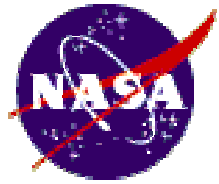
- Microwave map of sky with >95% sky coverage
- Observations with at least any 4 (of the 5) frequency bands
- Systematic errors limited to $<5\mu\text{K}$; calibration errors limited to $<1\%$
- Sensitivity and angular resolution must be sufficient that on angular scales $>0.25^\circ$, signal to noise ratio is $>\text{unity}$

- **Minimum Science Mission ***

- Microwave map of sky with >90% sky coverage
- Observations with at least any 3 (of the 5) frequency bands
- Systematic errors limited to $<8\mu\text{K}$; calibration errors limited to $<2\%$
- Sensitivity and angular resolution must be sufficient that for angles $>0.5^\circ$, the cosmological results are limited by the sampling statistics of our universe (“sampling variance”) and not by the MAP instrument.

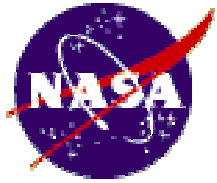
* The Red Team assessment assumes the PI-provided lifetime estimate of 27 months (24 months @ L2) for the Baseline Science Mission and 12 months (9 @ L2) for the Minimum Science Mission.

Mission margins for Baseline and Minimum Mission range from good to large



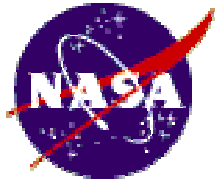
Processes Scores

| Process | Score |
|--|-------|
| Technical Peer Reviews | 7.3 |
| System Level Reviews | 7.6 |
| Integration & Test Plan | 8.1 |
| Mission Assurance | 7.4 |
| Systems Management | 8.5 |
| Staffing & Experience | 7.5 |
| Integration & Test Results | 8.9 |
| Operating Time | 8.6 |
| Technical Review Process Results | 7.8 |
| Mission Simulations/ Training | 8.4 |
| FMEA, FTA, PRA Process & Results | 8.8 |
| Mission Requirements Verification Matrix | 7.8 |
| Single Point Failure Analysis | 7.5 |



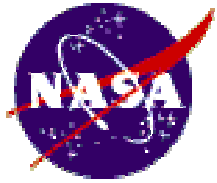
Process Scores

- Technical Peer Reviews Score 7.3
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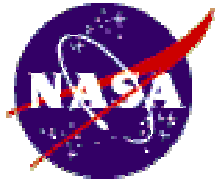
Process Scores

- Integration & Test Plan Score 8.1
 - Excellent systems engineering to define & flowdown requirements into a thorough and rigorous I & T plan
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 - Conservative & successful component test program
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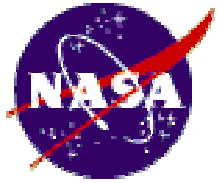
Process Scores

- Systems Management Score 8.5
 - Three of Goddard's best Systems Engineers
 - Exemplary risk management implemented from project start and maintained through program
 - Early risk mitigations very effective; selective redundancies added
 - Excellent and timely analyses
 - Good resources margins
 - Processes for management and control are effective
 - Analyses of mission trajectory design contingencies still in progress.



Process Scores

- Integration & Test Results Score 8.9
 - Comprehensive, successful test program with an extraordinarily low number of PFR's (74)
 - All critical hardware performed without failure; no removal of equipment from spacecraft for replacement or repair
 - Complex thermal design and model were validated
 - Innovative use of thermal vacuum followed by thermal balance to allow heater fine-tuning and full thermal-system validation
 - Instrument level test sequence (Cold-vibration-cold) allowed instrument performance validation
 - Software testing experienced relatively few problems
 - Highly experienced manager in charge of I&T program



Process Scores

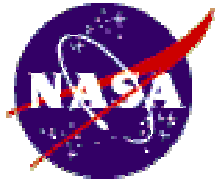
- Operating Hours *

Score 8.6

– Extensive number of operating hours accumulated at the Observatory level

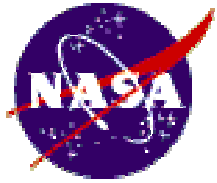
| <u>Component</u> | <u>Hours</u> | | <u>Component</u> | <u>Hours</u> |
|-------------------|--------------|--|----------------------|--------------|
| POWER SUPPLY ELEC | 4168 | | STAR TRACKER #1 | 1115 |
| MIDEX ATT CONTROL | 4067 | | STAR TRACKER #2 | 1063 |
| LITTLE MAC | 3721 | | DIGITAL SUN SENSOR | 1950 |
| XPONDER A (RCVR) | 3966 | | GYRO ASSY #1 | 1908 |
| XMITTER A | 1167 | | GYRO ASSY #2 | 1919 |
| XPONDER B (RCVR) | 3963 | | INSTRUMENT | 1104 |
| XMITTER B | 393 | | INSTRUMENT (pre-I&T) | 1080 |
| REACTION WHEEL #1 | 1854 | | REACTION WHEEL #2 | 1812 |
| REACTION WHEEL #3 | 1787 | | | |

* Hours as of May 3, 2001



Process Scores

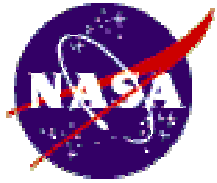
- **Training for Mission Sims, Launch and Operations** **Score 8.4**
 - Among the most comprehensive plans seen to date
 - MAP is an exemplary mission in the way it has organized, structured, and implemented the ground support and mission operations and training
 - Uses the same team, procedures, and database for both I&T and mission operations
 - Each flight controller assigned to a subsystem and followed that subsystem thru component testing
 - 26 Mission Simulations planned; 19 completed at time of PSR
 - Most contingency procedures not yet completed or practiced ; plan to complete prior to launch



Process Scores

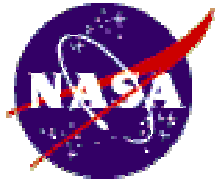
- **FMEA, FTA, PRA Process & Results** **Score 8.8**
 - FMEA & FTA performed early in the development and results used to select and incorporate hi-value reliability improvements (affordable within the financial margin)
 - FTA used to identify contingency procedures
 - PRA type analysis was performed to identify risk areas; 1 High (DC-DC Converters); 26 Medium & 20 Low risks identified (Red Team Scoring system) and rationale for acceptance was provided.

- **Single Point Failure Analysis** **Score 7.5**
 - 47 SPF's identified and risk mitigations developed for each to the maximum extent possible within resources constraints
 - The risks are consistent with the original paradigm for this class mission.



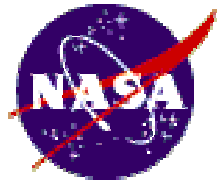
Residual Risk Rating System

| | | | | | | | |
|-------------|--------------|---|-----------|--------------------------|----------------------|-------------------------|-----------------|
| Probability | >10% | 5 | L | M | M | H | H |
| | >1% & <10% | 4 | L | L | M | H | H |
| | >0.01% & <1% | 3 | L | L | L | M | M |
| | <0.01% | 2 | L | L | L | L | M |
| | Non-credible | 1 | L | L | L | L | L |
| | | | 1 | 2 | 3 | 4 | 5 |
| | | | | | | | |
| Criticality | | | No Effect | Meets all Science Req'ts | Minimum Science Only | Loss of Minimum Science | Loss of Mission |



Residual Risk Ratings

| <u>Risk</u> | <u>Criticality</u> <u>(C)</u> | <u>Probability of</u> <u>Occurrence</u> <u>(P)</u> | <u>CxP</u> | <u>Comment</u> |
|---|----------------------------------|--|------------|--|
| Loss of any one of the single string boxes will result in loss of mission | 5 | 4 | 20 HIGH | The project purchased an additional ELV solid rocket that increased allowable payload weight thus providing some relief by enabling additional selected redundancy to the flight system. The Project has implemented a risk mitigation program through a robust design, manufacturing process control, testing, analysis, simulations and a thorough anomaly review/ disposition process. HIGH rating based on reliability predictions. Sense of Red Team is MEDIUM risk. |

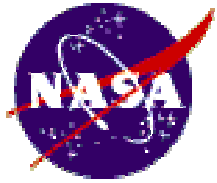


Mission Reliability Predictions

| <u>Mission Duration</u> | <u>Project Prediction*</u> | <u>Red Team Prediction**</u> |
|-------------------------|----------------------------|------------------------------|
| 12 months | 0.912 | 0.836 to 0.967 |
| 27 months | 0.813 | 0.685 to 0.939 |

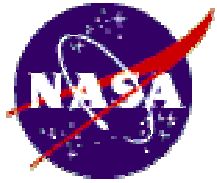
* Based on PRA and FTA data

** Battel analysis using best and worst case bounding assumptions, MAP configuration



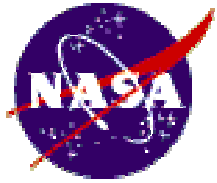
Residual Risk Ratings

| <u>Risk</u> | <u>Criticality</u> <u>(C)</u> | <u>Probability of</u> <u>Occurrence</u> <u>(P)</u> | <u>CxP</u> | <u>Comment</u> |
|--|----------------------------------|--|------------|---|
| Interpoint converters (and associated hardware) in Power System Electronics is a single point failure for the mission. | 5 | 3 | 15 MED | Issue has been mitigated effectively by work of parts branch. Qualification of fix has not been fully demonstrated by a large number of flight hours; potential for other factors affecting reliability cannot be readily mitigated. Two Interpoint converters with no redundancy; these each have over 4000 hrs. of operation. All reasonable mitigations exercised but some risk remains. |



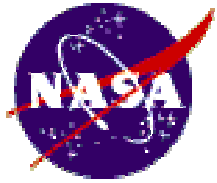
Residual Risk Ratings

| <u>Risk</u> | <u>Criticality</u> <u>(C)</u> | <u>Probability of</u> <u>Occurrence</u> <u>(P)</u> | <u>CxP</u> | <u>Comment</u> |
|--|----------------------------------|--|------------|---|
| PCB failures (2) due to short between PC Board and grounded heat sink (Litton manufacturing process problem). Both PCB's still on S/C. | 5 | 3 | 15 MED | Both failures occurred at the first application of power. A root cause has not been determined. No recurrences during all subsequent testing. Significant flight experience with previous hardware with same construction techniques. |



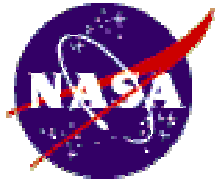
Residual Risk Ratings

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|---|----------------------------------|--|------------|--|
| Unsuccessful critical trajectory maneuver (either abort or maneuver execution with a significant error) | 5 | 2 | 10 MED | Execution accuracy should be understood prior to this event as there are several earlier maneuvers scheduled. The completed and planned comprehensive simulations and testing for this event will significantly mitigate this risk. In addition, 24 hours prior to a maneuver, contingency plans are developed and discussed in a Command Authorization Meeting of all disciplines involved. |



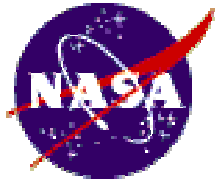
Residual Risk Ratings

| <u>Risk</u> | <u>Criticality</u> (C) | <u>Probability of</u> <u>Occurrence</u> (P) | <u>CxP</u> | <u>Comment</u> |
|--|---------------------------|---|------------|--|
| No end -to-end optical (i.e. microwave) test | 3 | 2 | 6 LOW | The project invested significant funding to perform a state of the art optical metrology program that characterized the TRS mirrors, the truss structure holding the TRS, and the focal plane/feed horn assembly. In addition a microwave system has more alignment margin because of the long wavelengths associated with that portion of the electromagnetic region. Everything practical has been done. Data collected indicates excellent correlation with instrument thermal model. |



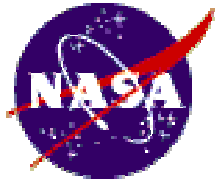
Comments on the Red Team Process

- **The MAP Red Team delayed its Phase One Review until just after the PER at the request of the MAP project**
- **MAP is among the first of the GSFC missions to have a Red Team evaluate their mission early enough to be able to influence decisions & implementation.**
- **Six of the weaknesses/residual risks identified in the Phase One Review were mitigated or eliminated by the Project and thus are not included in this report.**



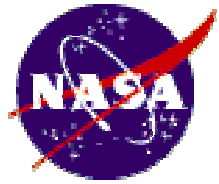
Summary of Findings

- **Matrix of 13 Processes** — The engineering and management processes scores ranged from very good to excellent with the single exception of the process for recording and closing recommendations from the Peer Reviews. The integration and test plan and results were both excellent as were the systems engineering, risk management, and the FMEA/FTA/PRA processes. The spacecraft accumulated over 4000 hours of operating time with very few problems. The mission simulations and training were numerous, comprehensive, and effectively conducted (one of the most extensive programs seen to date).
- **Residual risks** —There are 9 residual risks (1 Medium/High, 3 Medium, and 5 Low). The most significant risk is the single string design of the mission. This risk was partially mitigated during the design phase by the project's excellent use of marginal resources to incorporate selective redundancy and by a strong parts program. The success achieved in the very conservative and successful component & system level test programs has developed high confidence in the spacecraft and instrument. Still, many single string functions remain. A potential risk remains, associated with the shorts experienced on two Printed Circuit Boards; since the original problems were discovered at the box level, there have been no recurrences during the entire system I&T program. The risks associated with the critical trajectory maneuvers have been mitigated by the independent analyses, many simulations, contingency preparations, and the conservative fuel budget.
- **Launch Vehicle** — The Launch Vehicle Red Team has rated the MAP Delta launch vehicle as LOW risk.



Conclusion

- The Project has followed a very conservative and traditional policy in their engineering and management processes, with few deviations from previous NASA standards. They have performed structured, effective risk management throughout the development. The mission is rated in the Medium to Low risk range.
- The instrument development was rigorous and thorough and the history of performance has been excellent. Margins are very good with excellent prospects for achieving the baseline mission science objectives. The instrument testing has been thorough and although a complete end-to-end test is not possible, the test program has verified all critical parameters.
- The System level testing was exceptionally successful with no significant problems; the thermal vacuum/thermal balance testing was particularly challenging and was completed with no major problems.
- Design of the very critical trajectory maneuvers experienced difficulties in the early stages however the Project took effective steps to make the changes necessary to complete this work successfully.
- The Project Manager, Principle Investigator, and the System Engineers were particularly effective in their technical and management approach. Their leadership created a very strong team morale and sense of ownership.
- The Red Team would like to express their appreciation for the spirited cooperation we received from the entire MAP Project.

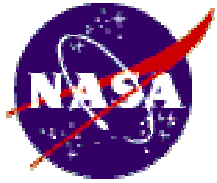


Appendix A

Charter

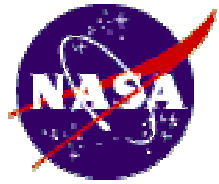
Scope

Evaluation Approach



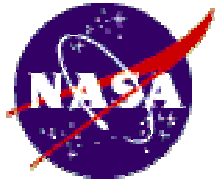
Charter

- **The Red Team was chartered by GSFC (POC Charles Vanek, Code 300)**
 - Charter Approved 4/28/2000, 4 Revisions thru Rev D 11/07/00
- **Objective** – “...to enhance the probability of the MAP mission success by bringing to bear additional technical expertise to review all mission critical aspects of the program implementation.”
- **Process**
 - Review critical technical development and operations of the mission implementation from the perspective of looking at what could go wrong and cause the mission to be less than fully successful.
 - Review thirteen key management & engineering processes used to implement the mission.
 - Identify and document all remaining risks that could be in-line with complete mission success.
 - Participate in the KSC ELV Red Team Mission Unique Review (Cross-membership)
- **Membership** - The Red Team shall have a membership that is external to the GSFC and is independent of MAP Project personnel.



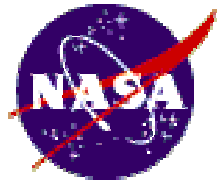
Scope

- **Spacecraft** - fully addressed.
- **Payload** - fully addressed
- **Launch Preparations, launch event and launch support** - fully addressed
- **Control Center** – fully addressed
- **Launch vehicle integration** - fully addressed
- **Launch vehicle mission unique changes** - fully addressed
- **Readiness for on-orbit operations** - fully addressed
- **Unique-to-mission changes to the ground station** - fully addressed
- **Launch vehicle conformance and implementation** - addressed via the KSC Red Team for Launch Vehicles (cross-membership from Mission Red team)
- **SOMO/institution mission operations** - addressed on a mission unique requirements basis only
- **Mission science operations** - limited to systems needed for data capture, processing, archiving and distribution only



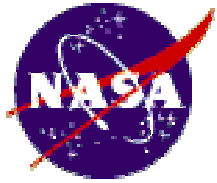
Evaluation Approach

- **Scoring for the 13 processes**
 - Each member scores every process.
 - The high and low scores are dropped and the remainder are averaged to first decimal place.
 - Range of scores is from 1 (lowest) to 10 (highest). Score of 7 is considered average.
 - Ratings are on an absolute scale.
 - Only the more significant ratings are addressed in the main section of this briefing. All process ratings are contained in Appendix A
- **Ratings for residual risks**
 - Members submit candidates for residual risks, including rationale
 - All team members evaluate and rate each residual risk
 - Final rating for risk is a consensus rating unless specified otherwise
 - Only risks rated Medium or High are addressed in the main section of this briefing. All residual risks are contained in Appendix B.
- **Ratings assume successful completion of remaining verifications, tests, & RFA's**



Appendix B

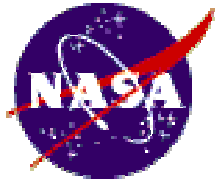
Scoring Details for 13 Processes



Process Scores

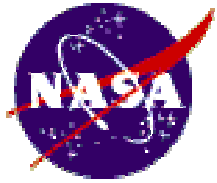
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 - Trajectory analysis and optical systems reviews were particularly strong, involving highly experienced, independent members
 - Significant number lacked formal RFA/closeout process; lacked uniform closeout process.

- **Systems Reviews** **Score 7.6**
 - Many formal reviews with 5 chaired by 300 and 4 chaired externally
 - Reviews were extensive and thorough. Experience level of reviewers was good.
 - Sound RFA/ closeout process followed.
 - Project was exceptionally responsive to review process.



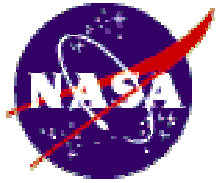
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Process Scores

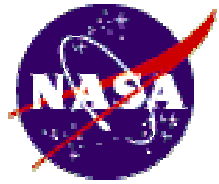
- Mission Assurance Score 7.4
 - More traditional (conservative) GSFC program used; thorough in all areas
 - Effective subcontractor control & surveillance
 - Well defined and sound policies and standards
 - Conservative radiation requirements program
 - Parts program (Class 3-modified) consistent with MIDEX class; screened commercial parts
 - Software was subjected to semiformal & informal reviews including build-test reviews and acceptance-test reviews.



Process Scores

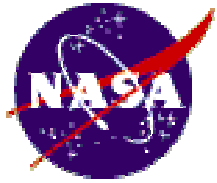
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 - Three of Goddard's best Systems Engineers
 - Exemplary risk management implemented from project start and maintained through program
 - Early risk mitigations very effective; selective redundancies added
 - Excellent and timely analyses
 - Good resources margins
 - Processes for management and control are effective
 - Analyses of mission trajectory design contingencies still in progress.

- **Staffing & Experience** **Score 7.5**
 - Experience level of the project office is excellent
 - Subsystem leads have lengthy experience or adequate experience complemented by branch support
 - PI has relevant COBE experience; Princeton staff also quite experienced
 - Staffing level is lean but adequate; excellent team morale.



Process Scores

- **Integration & Test Results** **Score 8.9**
 - Comprehensive, successful test program with an extraordinarily low number of PFR's (74)
 - All critical hardware performed without failure; no removal of equipment from spacecraft for replacement or repair
 - Complex thermal design and model were validated
 - Innovative use of thermal vacuum followed by thermal balance to allow heater fine-tuning and full thermal-system validation
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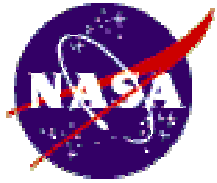


Process Scores

- Operating Hours * Score 8.6
 - Extensive number of operating hours accumulated at the Observatory level

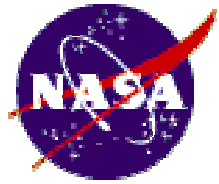
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| XMITTER B | 393 | | INSTRUMENT (pre-I&T) | 1080 |

* Hours as of May 3, 2001



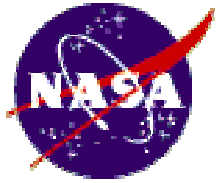
Process Scores

- **Technical review Results** **Score 7.8**
 - System review RFA dispositions have been good and are well documented with concurrence from originator in the case of formal reviews.
 - Responded to concerns of late RFA closure; current status has all RFA's closed
 - Project was receptive to results of reviews and incorporated suggestions into their program, for example responses to Red Team's questions and concerns on thermal testing & trajectory analyses
 - Most of the Peer Reviews had no formal record of RFA's or closures.



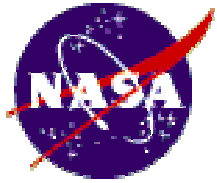
Process Scores

- Training for Mission Sims, Launch and Operations Score 8.4
 - Among the most comprehensive plans seen
 - MAP is an exemplary mission in the way it has organized, structured, and implemented the ground support and mission operations and training
 - Uses the same team, procedures, and database for both I&T and mission operations
 - Each flight controller assigned to a subsystem and followed that subsystem thru component testing
 - 26 Mission Simulations planned; 19 completed
 - Most contingency procedures not yet completed or practiced ; plan to complete prior to launch



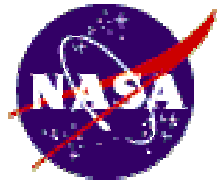
Process Scores

- Mission Requirements Verification Matrix Score 7.8
 - Thorough & controlled process to identify science and mission verification requirements
 - 206 total requirements identified, 171 verified, 30 in signoff; 0 non-compliant, 5 to be resolved.



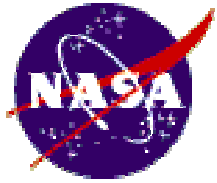
Process Scores

- **FMEA, FTA, PRA Process & Results** **Score 8.8**
 - FMEA & FTA performed early in the development and results used to select and incorporate hi-value reliability improvements (affordable within the financial margin)
 - FTA used to identify contingency procedures
 - PRA type analysis was performed to identify risk areas; 1 High (DC-DC Converters); 26 Medium & 20 Low risks identified (Red Team Scoring system) and rationale for acceptance was provided.
- **Single Point Failure Analysis** **Score 7.5**
 - 47 SPF's identified and risk mitigations developed for each to the maximum extent possible within resources constraints
 - The risks are consistent with the original paradigm for this class mission.



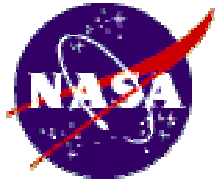
Appendix C

Rating details For Residual Risks



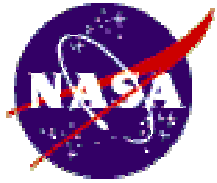
Residual Risk Ratings

| <u>Risk</u> | <u>Criticality</u> (C) | <u>Probability of</u> <u>Occurrence</u> (P) | <u>CxP</u> | <u>Comment</u> |
|---|---------------------------|---|------------|--|
| Loss of any one of the single string boxes will result in loss of mission | 5 | 4 | 20 HIGH | The project purchased an additional ELV solid rocket that increased allowable payload weight thus providing some relief by enabling additional selected redundancy to the flight system. The Project has implemented a risk mitigation program through a robust design, manufacturing process control, testing, analysis, simulations and a thorough anomaly review/ disposition process. HIGH rating based on reliability predictions. Sense of Red Team is MEDIUM risk. |



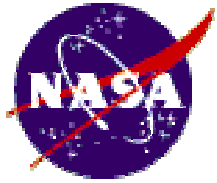
Residual Risk Ratings

| <u>Risk</u> | <u>Criticality</u> <u>(C)</u> | <u>Probability of</u> <u>Occurrence</u> <u>(P)</u> | <u>CxP</u> | <u>Comment</u> |
|--|----------------------------------|--|------------|---|
| Interpoint converters (and associated hardware) in Power System Electronics is a single point failure for the mission. | 5 | 3 | 15 MED | Issue has been mitigated effectively by work of parts branch. Qualification of fix has not been fully demonstrated by a large number of flight hours; potential for other factors affecting reliability cannot be readily mitigated. Two Interpoint converters with no redundancy; these each have over 4000 hrs. of operation. All reasonable mitigations exercised but some risk remains. |



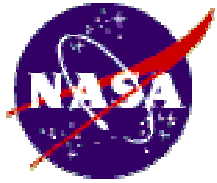
Residual Risk Ratings

| <u>Risk</u> | <u>Criticality</u> <u>(C)</u> | <u>Probability of</u> <u>Occurrence</u> <u>(P)</u> | <u>CxP</u> | <u>Comment</u> |
|--|----------------------------------|--|------------|---|
| PCB failures (2) due to short between PC Board and grounded heat sink (Litton manufacturing process problem). Both PCB's still on S/C. | 5 | 3 | 15 MED | Both failures occurred at the first application of power. A root cause has not been determined. No recurrences during all subsequent testing. Significant flight experience with previous hardware with same construction techniques. |



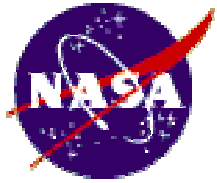
Residual Risk Ratings

| <u>Risk</u> | <u>Criticality</u> <u>(C)</u> | <u>Probability of</u> <u>Occurrence</u> <u>(P)</u> | <u>CxP</u> | <u>Comment</u> |
|---|----------------------------------|--|------------|--|
| Unsuccessful critical trajectory maneuver (either abort or maneuver execution with a significant error) | 5 | 2 | 10 MED | Execution accuracy should be understood prior to this event as there are several earlier maneuvers scheduled. The completed and planned comprehensive simulations and testing for this event will significantly mitigate this risk. In addition, 24 hours prior to a maneuver, contingency plans are developed and discussed in a Command Authorization Meeting of all disciplines involved. |



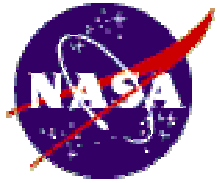
Residual Risk Ratings

| <u>Risk</u> | <u>Criticality</u> (C) | <u>Probability of Occurrence</u> (P) | <u>CxP</u> | <u>Comment</u> |
|---|---------------------------|---|------------|--|
| Potential contamination of the Digital Sun Sensor (DSS) by the Delta 3 rd stage motor; possible compromise of backup source for attitude rates | 2 | 3 | 6 LOW | An analysis based on extrapolation of TIROS flight data predicts possible deposition of 65Å of material on DSS. Possible that DSS performance would be effected but error could be calibrated out on the ground. AST's provide primary attitude information and the DSS is used as backup. |



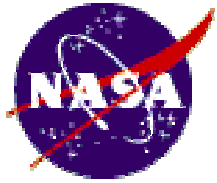
Residual Risk Ratings

| <u>Risk</u> | <u>Criticality</u> <u>(C)</u> | <u>Probability of</u> <u>Occurrence</u> <u>(P)</u> | <u>CxP</u> | <u>Comment</u> |
|--|----------------------------------|--|------------|---|
| Flight operations procedures (normal & contingency) are incomplete and may not be completed when required. | 4 | 2 | 8 LOW | The schedule for remaining activities before launch is very busy and there is a low risk that completing and certifying the flight operations procedures successfully may be threatened. The risk is mitigated by : 1) the detailed plan & added manpower implemented by the project. 2) many of the flight procedures will be modifications of existing I&T procedures. 3) establishment of a priority system for completion |



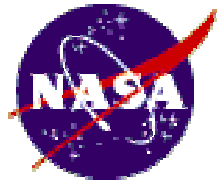
Residual Risk Ratings

| <u>Risk</u> | <u>Criticality</u> (C) | <u>Probability of</u> <u>Occurrence</u> (P) | <u>CxP</u> | <u>Comment</u> |
|--|---------------------------|---|------------|--|
| No end -to-end optical (i.e. microwave) test | 3 | 2 | 6 LOW | The project invested significant funding to perform a state of the art optical metrology program that characterized the TRS mirrors, the truss structure holding the TRS, and the focal plane/feed horn assembly. In addition a microwave system has more alignment margin because of the long wavelengths associated with that portion of the electromagnetic region. Everything practical has been done. Data collected indicates excellent correlation with instrument thermal model. |



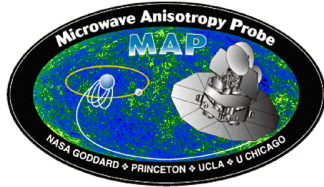
Residual Risk Ratings

| <u>Risk</u> | <u>Criticality</u> <u>(C)</u> | <u>Probability of</u> <u>Occurrence</u> <u>(P)</u> | <u>CxP</u> | <u>Comment</u> |
|--|----------------------------------|--|------------|--|
| Potential thrust misalignment, fuel inefficiency, and/or control variability due to thruster shift for thrusters #6 & #8 | 2 | 4 | 8 LOW | Post environmental check of thruster alignment revealed an in-spec (<1800 sec) but very suspicious thruster alignment change on thruster #8 (1145 sec) when compared to the changes on thruster # 7 (89 sec) on an essentially identical bracket on the opposite side of the S/C. Subsequent tests verified mounting structure integrity; blanket modified to reduce interference with strut; misalignment reduced; most probable cause was thruster movement on rubber shims. |



Residual Risk Ratings

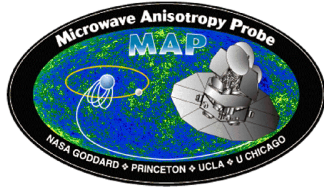
| <u>Risk</u> | <u>Criticality</u> (C) | <u>Probability of</u> <u>Occurrence</u> (P) | <u>CxP</u> | <u>Comment</u> |
|---|---------------------------|---|------------------|--|
| Collateral damage from the Star Tracker #1 survival heater failure | 2 | 3 | 6 LOW | The failed heater was not inspected and the postulated cause was handling damage during tracker rework. It is uncertain whether or not the failure is in a stable condition posing a low risk for collateral damage. Design mitigates risk via fusing of circuit, staking of wiring , and isolation of circuit. |



MAP Mission Readiness Assessment

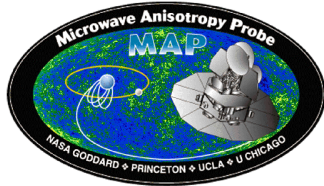
Bill Jackson

NASA IV&V Facility



Scope

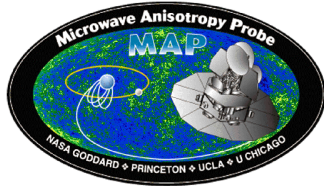
- Focus on mission critical software
 - Flight software
 - Ground software (control and monitoring)
- Developed MRA “questions to be answered”
- Assessment questions led to following tasks
 - Review software validation and operational testing
 - Analyze software trouble reports and change requests
 - Review hazard analyses/trees
 - Review requirements verification



MAP MRA Summary Findings

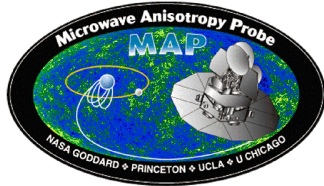
- The mission readiness assessment (MRA) primarily addresses mission critical SW.
- **Bold** indicates recommended prelaunch activities.

| MRA Question | Findings | Recommendation |
|---|---|--|
| 1. Has mission critical software been adequately verified? | <p>Mission critical software appears to have received thorough testing (unit through observatory). Failures and contingencies have been identified with software responses verified.</p> <p>Testing of peak loading conditions is unknown.</p> | Determine worst-case loading for processors and interface devices. Assess (prior to final verification of the SW) whether analysis or test has verified adequate capacity. |
| 2. Have software error trends demonstrated adequate reliability? | <p>As of early March, a large number of development DRs remained open (83 in analysis, 83 scheduled for fix).</p> <p>Early observatory testing (early April) indicate FSW and GSW PRs being opened/closed adequately.</p> | None. Reliability indication should result from recommendation associated with # 7. |
| 3. Has the integrated flight and ground testing performed all operational procedures? | <p>Substantial testing of Operational procedures is provided thru Observatory Testing.</p> <p>“Procedure tree” under development to confirm that testing covers Operational procedures.</p> | Verify that Observatory testing provides complete coverage via “procedure tree” |
| 4. Have software based controls of hazards responded as expected? | <p>Critical failures, hazardous operations, commands, procedures, fault detection and correction identified. Acceptance testing covers FDC.</p> <p>FMEA of mostly heritage ground system is in progress.</p> | After the ground FMEA is complete, verify test coverage of software-based responses to faults. |



MAP MRA Summary Findings (2)

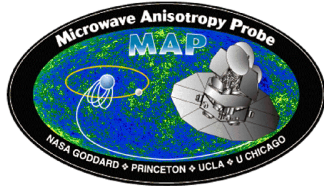
| MRA Question | Findings | Recommendation |
|--|---|--|
| 5. Have the different levels of integration and testing adequately covered the overall software verification needs? | <p>Test progression provides a solid, incremental approach to software test. Flatsat and Observatory test environments provide a appropriate tool-base for testing (use of STOL-driven test procedures).</p> <p>Some gaps in trace between system and software requirements(mostly heritage software). Trace of software requirements to test cases exists.</p> | None. |
| 6. Has duration testing been performed to confirm no degradation of performance? | <p>Observatory-level testing appears to provide sufficient, long duration operation of flight software.</p> <p>No duration –sensitive software problems evident in the DRs or PFRs.</p> | None. |
| 7. Were problems and issues adequately resolved? | <p>Number of open DRs are older than 6 months.</p> <p>DRs indicate proper and sufficient evaluation by stakeholders (including ops workarounds as appropriate).</p> | Audit outstanding DRs. Close or document plans for resolution prior to final verification of the software. |
| 8. Were latent code changes adequately tested? | <p>Test coverage adequately addresses latent changes.</p> <p>Regression testing (functional and performance) adequate. Testing performed at Acceptance and Observatory test level.</p> | None. |



IVV Response

MAP Response to IV&V Findings

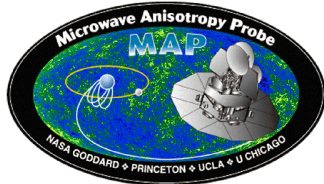
Liz Citrin



Response to IV&V MRA Recommendations

IVV Response

- Recommendation: Determine worst case loading for processor and interface devices.
 - Completed. Results forwarded to IV&V group.
- Recommendation: Audit outstanding DRs. Close or document plans for resolution.
 - Resources have been applied to DR assessment and closure. Current status is: 2 DR's open.



Response to IV&V MRA Recommendations (2)

IVV Response

- Recommendation: Verify that Observatory testing provides complete coverage (re: operations procedure testing)
 - All operations procedures, including contingency procedures, have been identified and prioritized. All launch critical (required for launch, IOC and normal ops, and contingencies thereof) will be verified prior to launch (plan presented at ORR).
- Recommendation: After the ground FMEA is complete, verify test coverage of software based responses to faults.
 - The ground FMEA is complete. Contingency procedures are included as part of the operations procedures and are being verified per plan.

MAP

MISSION READINESS REVIEW

INDEPENDENT READINESS ASSESSMENT

Josef A. Wonsever

May 22, 2001

MAP MISSION READINESS REVIEW

INDEPENDENT READINESS ASSESSMENT

Review and Mission Assurance Approach

- Tailored Technical Review Program Conducted by Code 301
 - Spacecraft, Instrument and Mission Operations
 - Early Systems Level Reviews Were Chaired by the MAP Project
- Peer Reviews Conducted by Project
- MAP Mission Assurance Conducted By Code 300
 - MDEX Assurance Requirements per GSFC-410-MDEX-002A (8/30/95)
 - MDEX Assurance Guidelines per GSFC-410-MDEX-001B (8/30/95)
 - Grade 3 Parts Program per 311-Inst-001 - Some Grade 1 & Most Grade 2 Parts, Very Few Commercial Parts
 - Effective PA Implementation Plans at Subcontractor and Instrumenter Facilities
- Would have been Class C per NMI 8010.1A
- Baseline Mission Life 2 years at L2, Minimum about 1 year
- KSC Responsible for the Med-Lite Boeing Delta II 7425-10 ELV

MAP MISSION READINESS REVIEW INDEPENDENT READINESS ASSESSMENT

MAP System Level Reviews

| <u>Review</u> | <u>Date</u> | <u>RFAs</u> | <u>Status</u> |
|---------------------------------|-------------|-------------|---------------|
| System Concept Review* | 7/96 | 107 | Closed |
| Spacecraft Design Review* | 1/21-22/97 | 39 | Closed |
| Instrument Design Review* | 3/3-4/97 | 29 | Closed |
| Confirmation Review (CDR/NAR)** | 6/17-19/97 | 37 | Closed |
| L-I Review*** | 1/6-7/00 | 8 | Closed |
| Flight Operations Review | 4/4-6/00 | 8 | Closed |
| Pre-environmental Review | 7/18-19/00 | 28 | Closed |
| Pre-ship Review | 4/10/01 | 8 | 4 Open |
| Operations Readiness Review | 5/11/01 | 0 | Closed |

* Project chaired review ** 301/D. McCarthy co-chair *** D. McCarthy chaired

MAP MISSION READINESS REVIEW

INDEPENDENT READINESS ASSESSMENT

Other Significant MAP Reviews

| <u>Review</u> | <u>Date</u> |
|---------------------------------------|-------------|
| Reliability Review | 5/97 |
| Operations Review | 3/98 |
| Electrical Systems Audit (Battel) | 9/99 |
| Spacecraft Charging Review | 9/99 |
| Optical Systems Review | 12/99 |
| Trajectory and Maneuvers Review | 12/99 |
| Mechanical Systems Audit | 12/99 |
| Delta Trajectory and Maneuvers Review | 9/00 |
| Red Team Review- Phase One | 9/00 |
| Red Team Review- Phase Two | 4/00 |

MAP MISSION READINESS REVIEW

INDEPENDENT READINESS ASSESSMENT

Except as noted, All RFAs For MAP Systems Reviews Are Closed

Remaining Reviews:

Flight Readiness Review ~ 6/25/01

Launch Readiness Review ~ 6/29/01

MAP MISSION READINESS REVIEW

INDEPENDENT READINESS ASSESSMENT

MAP RESIDUAL RISK ASSESSMENT

| <u>Issue</u> | <u>Residual Risk</u> | <u>Mitigation</u> |
|-----------------------------------|----------------------|---|
| Single Point Failure Modes | Low (low) | <ul style="list-style-type: none">- Test Program was thorough and relatively trouble free- Significant redundancy/graceful degradation included in design- Extensive failure free run time. |
| EEE Parts level (Grade 3) | Low (very low) | <ul style="list-style-type: none">- Extensive testing- Extensive consultation with 562- Many Grade 1 or 2 parts- Very few commercial parts. |

* (risk level for minimum mission)

MAP MISSION READINESS REVIEW

INDEPENDENT READINESS ASSESSMENT

MAP RESIDUAL RISK ASSESSMENT (Continued)

| <u>Issue</u> | <u>Residual Risk</u> | <u>Mitigation</u> |
|--------------------------------|----------------------|--|
| Lockheed Star Tracker | Low (low) | <ul style="list-style-type: none">- Passed full environmental test program- Can work around a failure with little impact. |
| Critical thermal design | Low (low) | <ul style="list-style-type: none">- Extensive analysis and test |
| L2 Orbit insertion | Low (low) | <ul style="list-style-type: none">- Extensive analysis/test- Special trajectory reviews with external experts |

MAP MISSION READINESS REVIEW

INDEPENDENT READINESS ASSESSMENT

MAP RESIDUAL RISK ASSESSMENT (Continued)

| <u>Issue</u> | <u>Residual Risk</u> | <u>Mitigation</u> |
|--|------------------------|---|
| Non-hermetic HEMT Amplifiers | Very Low (very low) | <ul style="list-style-type: none">- Cleaning process, purging- Graceful degradation |
| TRS debond problem | Very Low (very low) | <ul style="list-style-type: none">- Extensive analysis, repair, and retest. |
| Litton Printed Circuit Board Shorts | Very Low (very low) | <ul style="list-style-type: none">- Extensive testing- Low frequency of occurrence- Redundancy for critical functions- Stable in-flight temperatures |
| “EO-1” Transponder | Very Low (very low) | <ul style="list-style-type: none">- Redundant transmitters- Suspect board replaced- Successful retest |

MAP MISSION READINESS REVIEW INDEPENDENT READINESS ASSESSMENT

MAP RESIDUAL RISK ASSESSMENT (Continued)

| <u>Issue</u> | <u>Residual Risk</u> | <u>Mitigation</u> |
|---|------------------------|---|
| W-Band amplifier wire bonds | Very Low (very low) | <ul style="list-style-type: none"> - Extensive analysis and testing - Loss of affected differencing assembly is tolerable |
| Charging Issues (Surface and Deep Dielectric) | Very Low (very low) | <ul style="list-style-type: none"> - Extensive analysis/testing - Redundant ground paths in many locations |
| Solar Array Thermal Blanket Light Leaks | tbd | <ul style="list-style-type: none"> - New issue - analysis and fix in process |
| Solar Array Wiring Concern | tbd | <ul style="list-style-type: none"> - New issue - analysis and fix in process |

MAP MISSION READINESS REVIEW

INDEPENDENT READINESS ASSESSMENT

MAP RESIDUAL RISK ASSESSMENT (Continued)

| <u>Issue</u> | <u>Residual Risk</u> | <u>Mitigation</u> |
|------------------------------|----------------------|--------------------------------------|
| <u>“The usual suspects”:</u> | | |
| Interpoint Converters | Very Low | << Lid doubler fix implemented |
| Tin Whiskers | n/a | << Affected parts not used |
| ATC Capacitors | Very Low | << Ok'd by 562 and tested OK |
| Sprague Capacitors | Very Low | << Ok'd by 562 and tested OK |
| Vishay Resistors | Very Low | << Replaced with acceptable parts |
| Optocouplers | Very Low | << Design mitigation (filters) added |

OVERALL ASSESSMENT - LOW RISK MISSION
- LOW for minimum mission

MAP MISSION READINESS REVIEW

INDEPENDENT READINESS ASSESSMENT

Safety

- No Open Issues for MAP
- Routine Verification Tracking Log items remain to be worked as planned

MAP MISSION READINESS REVIEW

INDEPENDENT READINESS ASSESSMENT

Recommendation

Subject to resolution of new solar array issues:

Ready for Final Launch Processing

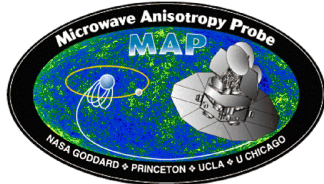


Your Section Name

OFFICE OF PUBLIC AFFAIRS

Nancy Neal

May 22, 2001

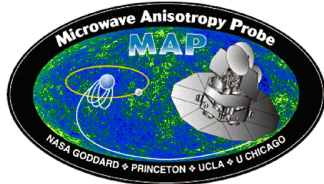


Your Section Name

MAP MEDIA PUBLIC AFFAIRS PLAN

Pre Launch

- Media training was held on May 21 for MAP Project personnel
- NASA will hold a L-14 press briefing from NASA HQ on June 12 @ 1 p.m. The briefing will be carried live on NASA TV
- NASA will issue a pre-launch press release on June 12 describing the mission and providing NASA points of contact for media interviews
- On approx. L-7, KSC will issue a Note to Editors explaining to reporters how to cover the launch of MAP
- NASA will conduct a L-1 pre-launch briefing at 12:30 p.m. and a L-1 science briefing at 1:30 p.m. from KSC Press Site live on NASA TV
- A Video File has been prepared and will air 2 days before launch
- Live shots are planned from Goddard's TV Studio on June 29. Live shots will be carried on NASA TV



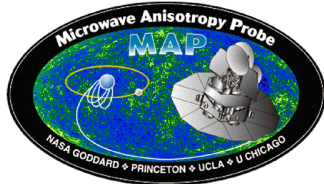
Your Section Name

Launch

- NASA will cover the launch and provide commentary live on NASA TV beginning approx. at 3 p.m.
- KSC will operate a MAP Press Site for the launch beginning at L-2
- KSC will provide commentary of the MAP launch on their V-2 voice circuit

Post Launch

- Following the launch a post-launch report will be issued by GSFC PAO
- GSFC PAO will periodically issue status reports through on-orbit checkouts and arrival at L2
- GSFC PAO will work closely with the MAP PI, in coordination with NASA HQ and the science institutions, for issuance of science releases and early science results
- A first science press briefing will be held at NASA HQ approx. 18 months after launch



Your Section Name

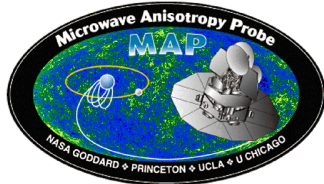
MAP PUBLIC AFFAIRS PRODUCTS

External

- PAO will create a MAP webpage where the MAP fact sheets, press kit and status reports will be posted. A link will connect users to the MAP Project website at <http://map.gsfc.nasa.gov>
- PAO Fact Sheet – currently in printing
- Project Fact Sheet-completed and available at <http://map.gsfc.nasa.gov>
- MAP Press Kit will be available in hard copy and electronically on the MAP PAO website- currently in review at HQ

Internal

- Goddard News - highlighted 4 weeks in advance
- Dateline – highlighted one week in advance
- Web Site – highlighted 2 weeks in advance
- Gate Signs – highlighted one week in advance
- Employee viewing will be held in the Bldg. 8 Auditorium



Your Section Name

MAP GUEST OPERATIONS

Pre-Launch

- Compiled list of names for guests invitations from MAP Project
- Entered names into the guest operations database
- Approx. 400 invitations will be mailed on May 23

Launch

- Check in for guest operations will be conducted from the KSC Visitor Complex beginning on L-2
- L-1 guest briefing will take place in the Universe Theatre at KSC @ 11a.m.
- Approx. 7 buses will transport guests to the NASA Causeway for launch viewing

Post-Launch

- Take visitors back the Visitor Complex
- Guest operations concludes